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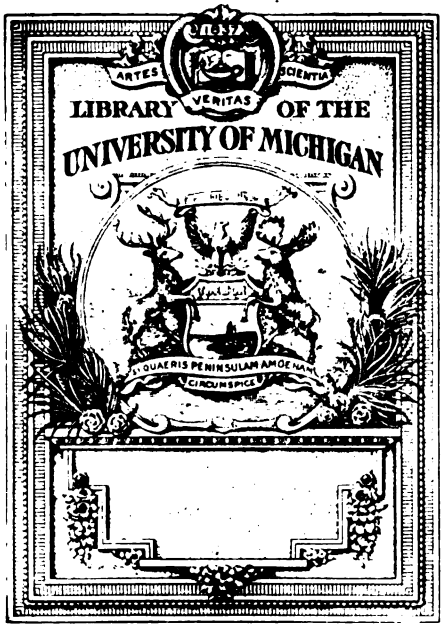
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BULLETIN

OF THE

American Bureau of Geography

VOL. I MARCH, 1900 No. 1

INTRODUCTORY

The American Bureau of Geography invites superintendents, principals, and friends of geography, as well as all progressive teachers of this important subject, to co-operate for the purpose of improving its teaching. The aim of the Bureau is two-fold: First, to make available to each member the valuable geographical material in the possession of his fellow members; and second, to establish influences helpful to the teaching and the teacher of geography.

In accordance with this aim, the plan of work of the Bureau includes :

1. Correspondence with educational men and women who are interested in geography and desire improvement in its teaching.
2. The organization of a system of exchange of products, geographic photographs, etc. An illustration will make this clearer. Suppose a fellow teacher in Southern Minnesota desires illustrative material for his geography classes. On the lists furnished every member of the Geographic Bureau, he finds the addresses of members in various states, territories and foreign countries, and notes the material each offers for exchange. He then places himself in direct communication with those members who offer what he wishes to secure; and in the meantime, with the help of his pupils, he makes up local collections for the subsequent exchanges

For the trifling expense of freight and postage every school can obtain a considerable collection of valuable illustrative material.

The descriptions accompanying each article, and written by the distant teacher or pupil; the making up of return collections and descriptions from the home locality; the attendant, tho perhaps incidental lessons on commerce and commercial highways; and the living interest which pupils will have in collections thus made, will all be of additional value.

The map on page three, the reports of committees, and the long list of members published in this number, will help to show the extent of the correspondence opened by the Bureau during the past three months.

3. The assignment of work to various committees and individual members and the publication of their reports for the information of all. Explanations and directions will be given each committee in subsequent communications. A brief mention of a few assignments is as follows:

(a) The committee on photographs includes every member and friend of the Bureau who has a camera, and is able and willing to use it for the benefit of himself and his fellow teachers. It is expected that this committee, over one hundred strong, and composed of members from various foreign countries as well as from all parts of our continent, will soon be able to furnish a good teaching collection for geography and physiography. Lantern slides will be prepared from the best of these photographs. The slides will be made by an expert and can be secured by members of the Bureau for twenty-five cents each.

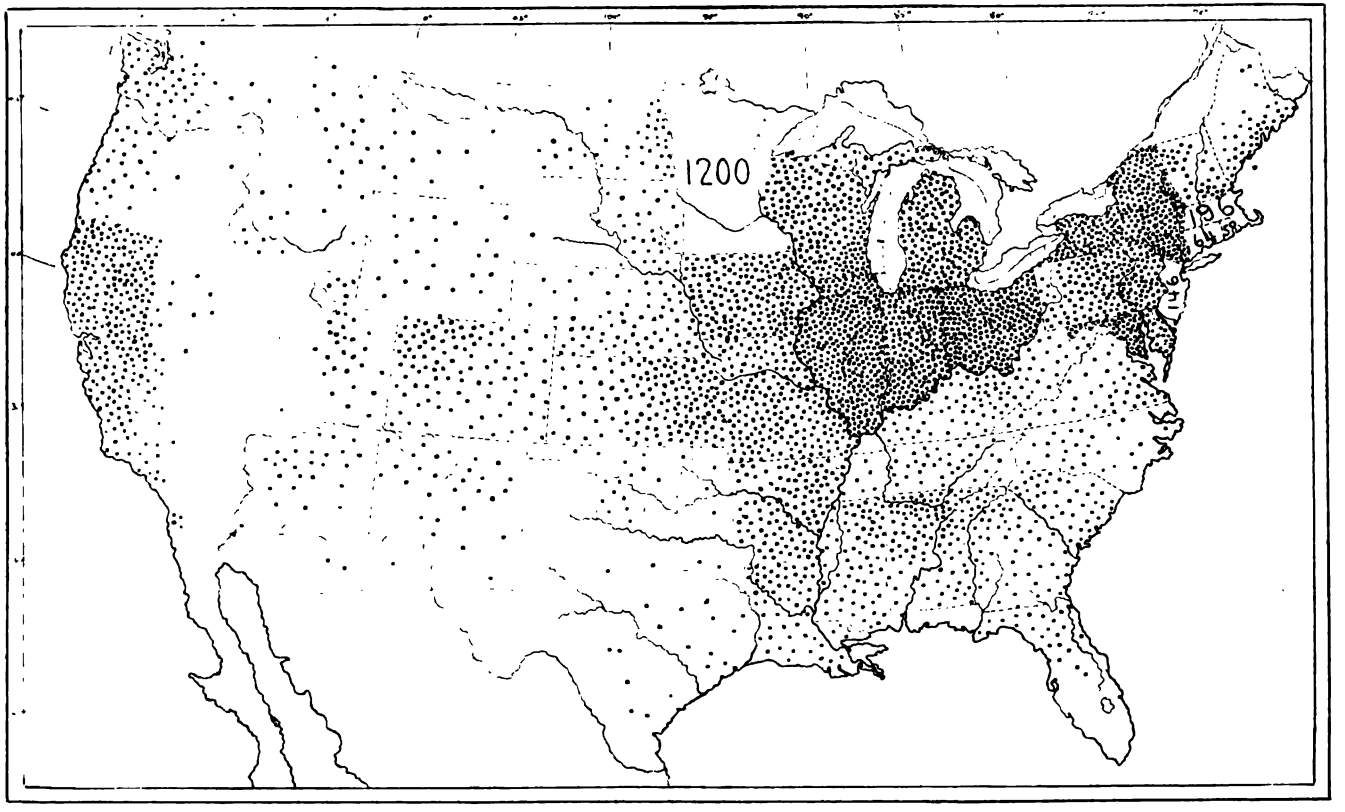
(b) The committee on magazines will have one member report all helpful articles in "Harper's Monthly," from Vol. I to the current number. A second member does the same for "Century." A third reports on the "Scientific American," and a fourth on the "Review of Reviews." All the other good magazines receive the same treatment; and the reports are edited and published in the Bureau's Bulletin.

(c) The committee on government publications will make a classified list of the valuable geographical material in

the reports of the United States Geological Survey, Smithsonian Institution, Bureau of American Republics, etc.

(d) Committees and individual members will report on: "Text Books," "Reference Books," "Apparatus," etc.; "Field Work," "Laboratory Work," "Map Drawing and Modeling," etc.; "Physical Geography," "Commercial Geography," "Mathematical Geography," etc.; "Geography in the Grades," "Geography in the High Schools," "Geography in the Normal Schools;" "What to Teach in Geography," "The Recitation in Geography," "Examinations in Geography," etc.; "Correlation in Geography Work," "What the Teacher in Literature can do for Geography," "How the Science Teacher can aid in Geography Teaching," etc.; "The Inductive and Deductive Methods in Geography Teaching," "The Topical Method," "The Chief Aim of Geographic Instruction," etc.; "Geographic Instruction in France," "Geographic Instruction in Germany," "The Teaching of Geography in Great Britain," "The Present Status of Geography Teaching in the United States," "How to Secure Recognition for the Proper Time and Equipment of our Courses in Geography," "The Training, Work and Salary of the Geography Teacher," "The Organization of State Geographical Associations," and many other subjects of interest to the average teacher of geography. It is hardly necessary to indicate that the Bureau will secure the best available men for each subject.

The Bulletin of the American Bureau of Geography will be published quarterly and will be sent free to every member of the Bureau. It will contain the addresses of members, and lists of the geographic material they wish to exchange, as well as reports, papers and communications from the committees and working members. The cost of publication and distribution is covered by the annual membership fee of one dollar.



Map showing number and approximate distribution of persons (in the United States) recently invited to take part in the exchange of geographic material, and to co-operate for the purpose of bettering the teaching of geography.

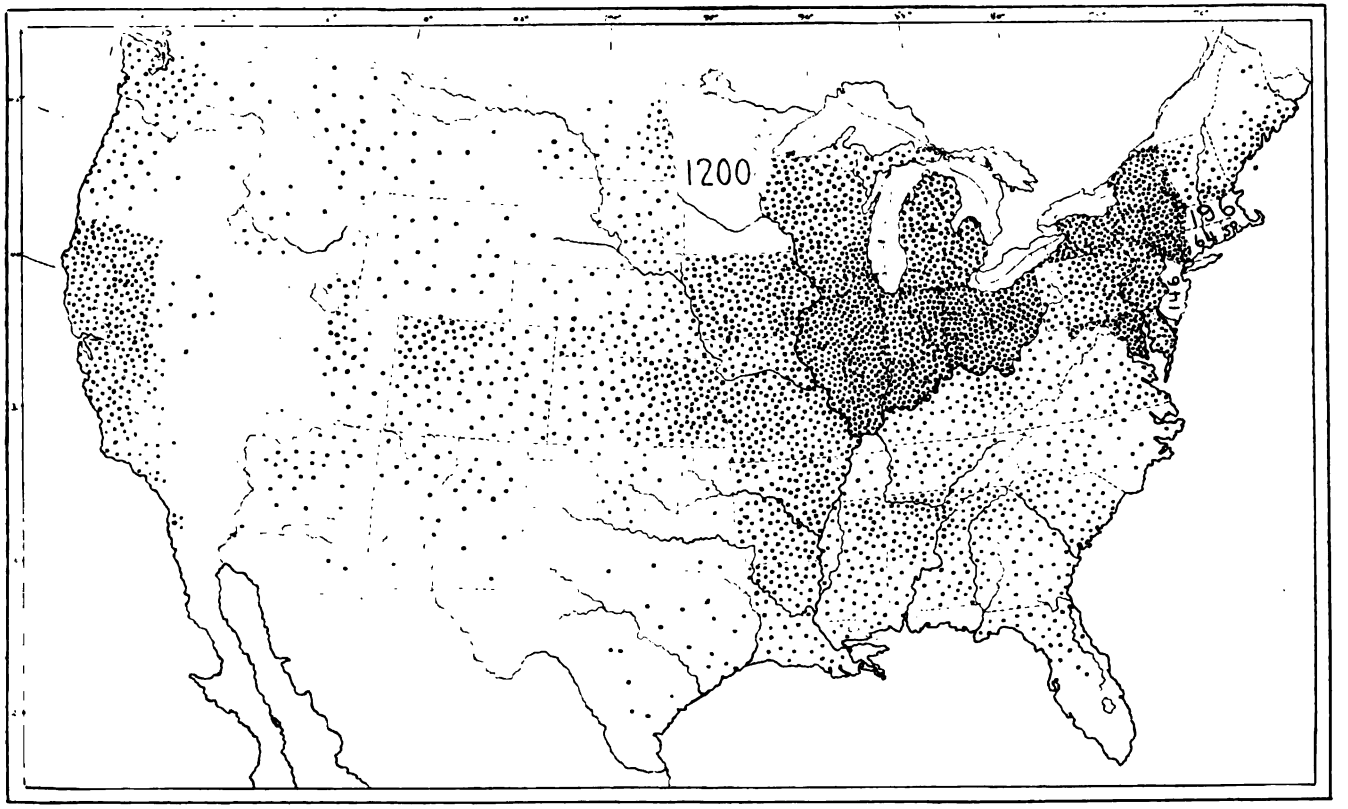
EDUCATIONAL VALUE OF GEOGRAPHY STUDY

BY ELMER I. MILLER, STATE NORMAL SCHOOL, CHICO, CAL.

The educational value of geography study is not a new subject. It has been discussed so much that it is almost exhausted. For that reason the purpose of this paper is not to set forth new ideas so much as to place the value of the subject freshly before us. This is done in the belief that it is occasionally desirable that the geography teacher take an inventory of his stock in trade, in order that he may know in what department he needs to replenish his store. He must keep before his mind's eye the reasons for teaching geography, the ends to be attained, else the results are apt to be poor or uncertain. In other words the teacher must know why the subject is to be taught, what it can do to educate the child, in order to know how to teach it. Method depends largely upon what is to be accomplished. So I repeat, the object of this paper is to bring freshly to the minds of geography teachers the reason for teaching geography, that the best methods of teaching may be secured.

Of course the value of any subject in the school course and the time it should have in that course, depend on how far it is suited to preparing the pupil for adult life by giving a practical education. I do not mean practical in the commercial sense of making money, but practical in the sense of rounding out all the faculties of mind and body at the same time that it is fitting for the problems of industrial life.

To such as may think this paper too enthusiastic in its claims for geography, I call attention beforehand to the fact that it does not claim all these advantages for geography alone. It does not claim that some of the same results might not be secured by other subjects also. It simply tries to show in what ways geography may have educational value. Moreover in giving the value of any



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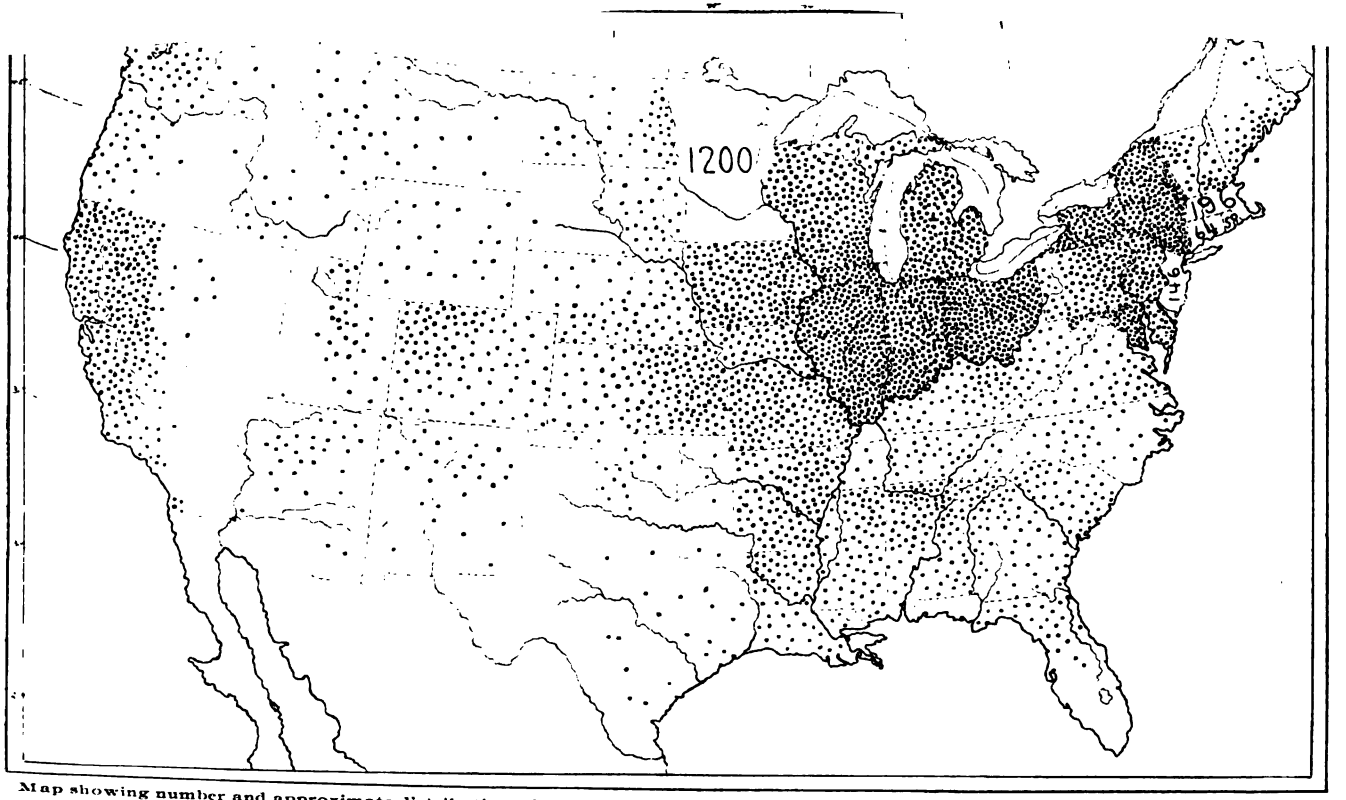

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study alone it must appear to be emphasized more strongly than if it were treated in conjunction with other branches. Indeed, the absence of the other subjects of itself unduly emphasizes the one discussed.

In this paper the educational value of geography will be discussed under four general heads, as follows:

1. As an information subject;
2. As an aid to other subjects;
3. As a disciplinary subject; and
4. As a culture subject.

First, then, geography as an information subject holds with history as high a place as any school study. In comparison with other sciences it is superior to any, because it comprehends something of each. While the study of geography will not furnish full knowledge of astronomy, geology, physics, or biology, it will give some information in all those special subjects. No one of the sciences just mentioned gives such general and broad information as geography. Tho in its higher forms of mathematical and physical geography it comes properly as a summarizing of certain of the sciences, what science *is* taught in geography may be of the most elementary kind and thus adapted to the powers of children. It thus may be a foundation for real science work. For general information alone then, it certainly gives more than any one of the other sciences. Omitting history, subjects other than sciences, are, like each individual science, confined to one particular kind of information and hence do not give so much general knowledge as geography.

To make clear what is meant by geographical information as here discussed, a few illustrations will be given. First, geography teaches structure and climate, two of the most important factors concerned in man's progress. No student of history can fail to see their great value in explaining the condition of individuals, of nations and of races. Life other than that of man has been influenced to an even greater degree. The natural distribution of plants and animals depends upon structure and climate, and man, tho he has done much, has not been able to make life thrive where nature said it should not. Man cannot transplant tropical life into Arctic regions or vice versa and make it thrive. Neither has man himself ever made great progress elsewhere than in the temperate regions. In the tropics nature is so lavish, little effort is required

to secure food and shelter; but the climate is so enervating there is little energy and less desire left for advancement. In the frigid regions the conditions of life are so hard that all man's energy is required to maintain life. Only in temperate climates is man able to live and yet have energy and time for improvement. Structure has much to do in determining climate, as seen in the difference between the east and the west slopes of the Sierra Nevadas or between the north and the south slopes of the Alps. But further discussion on this point is unnecessary as what has been said is sufficient to show my meaning.

Again, commerce may be advanced by geographical knowledge. Before trade can be extended it is necessary to know the productions and the needs of the new region. A commercial house in San Francisco desires to extend its operations by selling goods to Japan. It must first learn what products of the same or similar kinds are found in Japan. It must know the possible substitutes, if any, for its product. It must know that the Japanese use this or a similar article. It must know what products of Japan can be brought back to San Francisco. so the ship may have cargo both ways, for that will lessen cost of transportation. In other words the house must know Japanese products, the imports and exports of Japan, and something of Japanese modes of living. This is all a part of geography, and if properly taught, geography would do much to aid in the extension of trade ventures. At the present time the chief occupation of our consular service is to find out the geographical knowledge above mentioned, and it is upon these consuls that the merchants depend largely for their knowledge.

A third illustration is that it gives much knowledge of the laws of nature, such as those governing winds, movements of waters, action of the sun, and other forces now acting to change the surface of the earth. These, thru their influence on climate, soil, and animal and plant life, very much affect man and his progress. Much knowledge regarding these subjects has been reduced to law and it is a part of geography. Tho many other examples of valuable information given by geography study might be cited, it seems unnecessary to do so, for what has been said shows it to be a valuable information subject.

Second, geography is valuable as an aid to other subjects. In some of its phases it is an aid to most subjects, but to no other study is it so valuable as to history. It tells us at least in part why

various peoples are in different stages of advancement; why the Esquimo and central African are more backward than Europeans; why some people are traders, others military or naval powers, others literary; it gives opportunity for studying the laws, habits and customs of other peoples; by giving clearer images of the various regions of the world, it adds new life and interest to events happening in those regions: e. g. the wars in South Africa and in the Philippines would be much better understood had we a clear image of the geography of those countries. A knowledge of the geography fixes historical events more firmly in mind.

Geography is also an aid to language work, both in composition and reading. Some of the most interesting and valuable subjects for composition work are those taken from geography, for they are about real things that the children can examine in some instances or read about in others, and are definite. They are subjects about which children either know or can know something. Geography also furnishes a valuable source of supplementary reading.

Third, geography has great power for mental training. The old idea that the classics and mathematics were the sole disciplinary studies, has passed away. Nearly every subject of the school course now holds its position because it has disciplinary as well as informational value. Geography is no exception to this. In some respects it holds a very high place.

As a means of cultivating the memory geography has few if any superiors. But it is as a means of developing the perceptive, imaginative and reasoning faculties that I wish especially to speak of it.

Elementary geography, in my estimation, ought to be essentially a study of home geography, and therefore should be taught by observations. The child must observe the forms of nature around him and try to reproduce the image he has of them. Such reproduction is likely at first to show the image not clearly formed, hence the observation must be repeated, often several times, before an approximately correct image is produced. The repetition leads to carefulness, until finally the habit of careful and correct observation is fixed.

The imagination is one of the most valuable of the mental faculties. And here let me say I do not mean the involuntary and unrestrained imagination commonly called phantasy or fancy, but

the voluntary scientific imagination which reconstructs or recombines into a new image, elements already in the mind. I speak of that kind of imagination which enables the architect to construct in his mind's eye the building in its parts or as a whole before he puts the design on paper; or enables the inventor to see each part of his machine working in connection with all other parts, as a whole, before he makes the machine; or enables the reformer to so understand the needs for reform and the effect of his proposed reform measures that he can foresee them working out successfully in real practice. Such is the imagination which is so valuable to man.

And how does geography cultivate it? After leaving local geography it is no longer possible to see geographical facts and features save by forming an image by means other than observing the object itself. Either words or pictures must be used. These thru the imagination change the small hill or stream of the district to the large mountain or river at a distance. Without imagination it would be impossible, but the act in turn serves to develop the imagination still further. But there is no better part of geography to develop the scientific imagination than that termed astronomical. Constant efforts to image the positions and relations of the sun and planets, the resulting zones, climates, seasons and day and night, call for the highest activity of the imaging power. Again, the geography student must map out in his mind the ocean currents and winds. He also must picture the continents and on them the distribution of plant and animal life. These things cannot be well done by the little child, but constant effort to do so develops and strengthens the imagination until the task is comparatively easy

The one other faculty to be discussed under disciplinary value is reason. Geography—particularly physical and mathematical geography—deals essentially with causes and effects. The study of these subjects may be a series of "why's." Existing climate, differences of climate, weather, seasons, day and night and innumerable other phenomena must have causes for their existence; there must be reasons for their being as they are. To find out the "why's" develops the reason. Cities are located where they are for various reasons. All villages founded do not grow into cities; why not? If geography teaching is worthy the name, the reasoning power must receive much training.

Fourth, geography gives culture. For this purpose it is not equal to history or possibly to literature, but it is an important means of culture training when connected with these subjects. Perhaps nothing serves so well to give breadth of mind and liberality as travel. The traveler comes in contact with other peoples, their ideas, institutions and learning, and culture is the result. The best substitute for travel is that subject, or those subjects, that tell most of the things observed by the traveler. These subjects are geography, history and literature. Geography and history most nearly serve the purpose.

In conclusion it must be said that the results claimed in this paper for geography study will not be secured unless care is used in the selection of materials and methods. Like any other subject, geography includes more than can be taught in one particular school; hence it is desirable to select those parts of the subject that will do most to secure good results. In general it may be said that inert, lifeless things, as lists of capes, headlands, islands, etcetera, called by the Committee of Ten "*Sailor Geography*," will not do much to train the mind. But if life-influencing facts and forces such as soil, climate, slope, are taught, and taught intelligently, there need be no doubt about the educational value of the results.

WHAT TO TEACH IN GEOGRAPHY

BY HENRY McCORMICK, STATE NORMAL UNIVERSITY, NORMAL, ILL.

Geography is a large subject. It treats of the earth as the dwelling place of man,[1] and consequently has to deal with all the phenomena of the land, the water, and the atmosphere. These three elements, with their action and reaction upon each other constitute a field so vast that the student is in danger of losing his way in trying to tread its mazes. But, when to these are added the many ways in which geography affects both the material and spiritual interests of man, he may well be excused for crying out in the agony of his soul, Who is equal unto these things!

There are so many facts that to attempt the mastery of all is unwise. Fortunately, however, all are not of equal importance. Some are more worthy of attention than others. And the teacher must know the subject well enough to be able to distinguish the important from the unimportant, and be strong enough to disregard the latter and concentrate his efforts on the former.

He must do this if he would aid his pupils in obtaining a creditable knowledge of geography. If he attempts to teach all the facts, he will teach nothing. Instead of leading his pupils into the fields of knowledge, he will lead them into the mists and fogs of despair, thru which it is impossible for them to see anything with certainty.

This is where many teachers err, especially those who believe that to teach is to hear the pupils recite what is printed in the text book. They expect the children to learn the facts, all the facts, and only the facts found in the text. To add one, they regard as a crime equaled only by the omission of one. They are not aware, evidently, that if their pupils learned all the facts in an average text book on geography, they would be in danger of becoming idiots. Not even all of the important facts can be taught.

[1] Guyot.

School life is too short for such an undertaking. Only a comparatively small number should be attempted, and these should be selected with great care; otherwise there will be a waste of time and energy. To guard against such waste is the purpose of this article.

Much is said now-a-days in educational circles about the importance of nature studies. This is well. It indicates a turning of attention to the great book of nature, which is opened wide to all who will read it. There seems to be a general awakening to the fact that the great purpose of all that exists in finite nature is the education of man, and that the material is admirably fitted for the purpose.

Geography is a nature study, and the field for its pursuit is the home neighborhood. Here may be found all, or nearly all geographical forms. Here may be studied land, water, and air, with their action and reaction upon each other. To this action and reaction is due the usefulness of the earth to man. The agencies by which they are carried on are the rain, heat and cold, and the wind, and they are not confined to any one place. The results of their work may be seen in every locality. They are working now as they have worked in the past, and they are working in the home district as they are thruout the world. So that the home neighborhood is the world in miniature, and its study is the key to the study of the entire world.[1]

The importance of a careful study of the home neighborhood will be still further revealed when we reflect that there is no geography in a book. Between its covers are symbols in the form of words, pictures and maps, but these do not constitute geography. That is found outdoors, in the world about us, and must be studied there, if studied at all in the true sense of the term. When thus studied, the geographical concepts acquired will enable the student to put meaning into the symbols. And the fuller and closer his study, the more significant they will be.

In connection with the study of the home neighborhood, the pupils should be taught to read a map correctly. Many of them now make it the chief end and object of their study. For them there is nothing beyond. The map hides the world from their view, instead of revealing it. They go on studying the geography of the map without a thought of that for which the map stands.

[1] Ritter.

The teacher is blamable for this. He should so teach, that his pupils in studying the map should think of the forms of real land and water which the symbols are intended to represent. Back of the slightly waving line should be seen the flowing stream; back of the green surface of the map should appear the fertile plain; and back of the brown surface, the plateau, etc. This happy condition will prevail if the children have been led to study the home vicinity before studying maps. In making maps of the localities studied, they know that their maps represent real places and things, and it will soon dawn upon them that the printed maps also represent real places and objects. That is, the thought of the object or place will come before that of the map. This is very important.

Having taught our pupils to read the map correctly, we are prepared to use it in our teaching. We have reached the stage at which the movement must be from the symbol to the thing, thus reversing the order from what it was when teaching the home neighborhood. This can now be done with safety as the pupils have acquired power to interpret the symbols.

At this point we are compelled to decide what places and facts we shall teach. We cannot afford to work at random, but must select with great care. What shall determine our choice? This question each teacher must answer for himself. There are a few directions, however, which may be helpful, especially to the young. They are not given in the order of their importance, but as the writer happened to think of them.

Nearness to home is an important factor in favor of teaching a place. What would be entirely proper to teach in one locality might not be worthy of teaching in others. Location frequently renders the place important or unimportant.

Size of cities, rivers, lakes, mountains, etc., may make them worthy of being taught. There are a few cities, such as London, Paris, New York, Chicago, and others, whose size entitles them to attention. It will be found, however, that their size is due to causes which call for careful study. Certain large rivers so influence the lives of all who live within reach of them, that they cannot and should not be ignored. The same is true of all large bodies of water and of great mountain systems. Their influence upon humanity should always be the test of their worth.

Great manufacturing centers, with the principal lines of

manufactures carried on in each, should be taught. It will not be difficult to lead the pupils to see why Minneapolis is a great manufacturing center, and why flour and lumber are the principal products. The falls in the river, and the great wheat fields and pine forests near-by tell the story. The reason for Pittsburg's extensive iron and steel works is easily seen; and the same is true of Philadelphia's shipyards. These are but few of many manufacturing cities that should be taught, but must be omitted here for lack of space. These few, however, are sufficient to convey my thought to the reader, and that is all that is intended. Let me add that in every instance the manufactures of the city should be connected as far as possible with the products of the surrounding country.

Commercial centers are also worthy of being taught. It will be found in many instances that commerce and manufactures have gathered at the same points. This will make both the teaching and studying all the more interesting, as it will cause the cities to be approached on different sides, which is always an advantage.

History is so closely related to geography that many places will be taught simply for their historic associations. The Concord and Chickahominy rivers are small streams, but they are important ones to every American boy and girl. Gettysburg is an insignificant village, and so is Appomattox Court House, but to Americans they are well worth knowing about. The same is true of scores of other places both at home and abroad, but especially at home.

What may be termed literary centers, for the want of a better name, should also be taught. "The Landing of the Pilgrim Fathers," "Paul Revere's Ride," "Barbara Frietchie," "The Lady of the Lake," "The Charge of the Light Brigade," "Bingen on the Rhine," "David Copperfield," etc., have enlarged and enriched the field of geographic study. To omit teaching places that are famous in literature is to deprive the children of much pleasure. It is wrong to do so, and the teacher of geography should be above doing wrong, especially in this direction. It is true that the study of geography should be a pleasure in itself, and so it is when geography is properly taught. Nevertheless it will do no harm to light it up occasionally with the flood of sunshine and gladness that the poem or the artistic prose selection casts upon it.

The importance of relative position should be dwelt upon. The topic is worthy of careful consideration on the part of the

teacher. It is probably the most important one that he is called upon to teach in the grades. Places on the windward side of the mountain are well supplied with water, have a fertile soil, and a luxuriant vegetation; while those on the leeward side are parched with drouth, have sterile soil, and a dearth of vegetation. Places at the foot of the mountain have warmth and life; those on its summit, wintry blasts and death. Places in high latitudes begrudge the inhabitants their scanty food, but places within the tropics provide bountifully. The provinces on the south-east coast of Australia are prosperous, and have many opulent cities; those on the west coast, with their few insignificant towns, are dragging out a joyless existence.

It will be seen on investigation that many cities owe their greatness to their position. Not only so, but the industries by which they have become great are due to the same cause. The very existence even of some cities is due to the conditions that prevailed at certain points, and that called them into being. And altho we may not be able to see the reasons for the location of all cities in their present positions rather than at other places, we can discover the originating causes of so many, as to impress upon our pupils the importance of relative position. To cap the climax, it can be shown that much of the wealth and life, the joy and gladness of the earth itself is due to its position with reference to the sun.

In the earlier paragraphs of this article, it was stated that the action and reaction of the land, water, and air upon each other could be taught successfully. The pupils have now reached a stage in their development when the results of the action and reaction should be enlarged upon. Several familiar illustrations of evaporation and condensation were cited in the earlier stage; these should now be made the basis of further work.

The circulation of the waters should be made very clear. The topic is an interesting one, and if properly taught, can be brought within the comprehension of pupils of the fifth grade. To defer it until they reach the High School would be a mistake, as a knowledge of it is necessary to a proper appreciation of much that comes before.

If evaporation and condensation are understood, the function of the winds as water carriers will be seen; as will also the fact that all the waters discharged by the rivers into the sea cannot

exceed what has been taken out of it by evaporation. The office of the winds as equalizers of temperature will also be revealed. Their beneficent work in carrying the heat from where it is in excess to regions where it is sorely needed, making all parts of the land fit for the habitation of man, will be understood.

The ocean currents also act as equalizers of temperature, and should be taught. The blessings which they carry to the countries whose shores they wash gladden the hearts of millions. Among these blessings are an equable climate, a fertile soil, and a rich vegetation. Wherever they go, they introduce the conditions of a higher and nobler life; and like the winds, they owe their existence to the sun.

The influence of contour in geography, as revealed in history and civilization, should be carefully taught. The topic is a fruitful one, and will repay both teacher and pupils for their labor. It is also a fascinating topic, and the more it is studied, the greater will be the pleasure.

The irregular coast-line of any continent or country, if studied as a coast-line simply, has little to arouse our enthusiasm or to incite us to labor. Its ragged and tattered appearance awakens our pity, reminding us of the frayed edges of a beggar's garment rather than of the rich fringes of a monarch's robe. Yet in its seeming poverty lies the great wealth of the continent. Its peninsulas reach out into the sea and its gulfs penetrate the land, bringing all parts within easy reach of the water. The peninsulas receive the vapor on three sides, while the gulfs form gateways thru which the life-giving fluid reaches the interior. The vapor thus carried on the wings of the wind fertilizes the soil and causes it to produce abundant vegetation, which in turn affords sustenance for animal life.

Man appears on the scene, kills some of the animals for food and clothing, and domesticates others. He soon learns to cultivate some of the plants and to use them as food, and so is doubly secured against the attacks of hunger. His wants increase as do his opportunities. He needs a house, and builds it. He craves for better food, better clothing, and pleasanter surroundings—and he obtains them. Books, schools, and churches are at first a luxury, but they soon become a necessity. So he goes on step by step, rubbing against his fellows and wearing off his sharp

corners, until he becomes the polished gentleman, with whom we like so well to associate.

The indentations of the coast-line form not only gateways for the vapor, but they also form fishing grounds, which supply many of the needs of the early inhabitants. Here the men from opposite shores meet and compare their primitive canoes and fishing tackles. Some have better appliances than others, and the better ones are imitated by the less skillful fishermen. Progress is slow at first. Nevertheless, patient, persistent effort is crowned with success. The rude, hollowed log gives place to the light and graceful canoe. The paddles are laid aside for the sail, which in turn is replaced by steam.

Man's power over the sea is increased. He finds fishing so remunerative that he gives it most of his time. This opens a market for his brother who tills the soil, and who, having more than he needs for his own use, gladly exchanges some of it for fish, of which the other has a superabundance. Commerce is thus started, and is carried on at first in the form of barter, but later by means of some conventional medium of exchange. The interested parties see that it would be to the advantage of all if some fixed place was selected as a trade center, and so the commercial city comes into existence.

Prosperity creates new wants. To satisfy these, voyages are made to distant regions. The voyagers return, bringing not only the desired articles, but also reports of what they have seen and heard. Some of these are so marvellous that other adventurers determine to test their truthfulness. Foreign commerce is established. New ideas are introduced, and the people dropping their crudities, take upon them the polish of their more favored neighbors. And all of this because the indentations of the coast-line furnished good harbors.

The relief, or surface of a country, is also a potent factor in its civilization, and should be taught. The altitude of a country has much to do in determining its climate, more even than does the latitude in some countries. On the climate depends the character of the soil, and on the soil the vegetation. And all of these shape the occupations of the people in a large measure. The rough surface and barren soil of New England were important factors in turning the attention of its people from agriculture to manufactures. An additional elevation of a few hundred feet

would make Switzerland as dreary as Tibet. And Tibet itself, the land of desolation, situated in the same latitude as the fertile plains of Hindustan, bears witness to the controlling influence of elevation.

In South America the traveler can pass in a few days thru all the climatic zones. On the same parallel he finds the luxuriance of the tropics, the moderation of the temperate zones, and the poverty of the arctic regions. And the all-sufficient explanation of the difference, he finds in the difference of altitude.

Historians ascribe the high civilization of ancient Greece largely to its horizontal and vertical configurations. The irregularities of its coast-line brought all parts of the land within easy access of the sea, and the Greek became a seafaring man, visited all parts of the known world, and brought home new ideas, which took deep root in Hellenic soil, and produced a rich fruitage. The surface was traversed in various directions by ranges of mountains that cut the country into many small areas, in each of which a state was established. The mountains, while high enough to form natural barriers, did not hinder communication among the states. And mutual intercourse among them produced a spirit of emulation which carried Greece to the high-water mark of ancient civilization.

I would not teach that the high civilization of Greece was due solely to its contour and relief, as that would not be true. There were other factors, and important ones, a discussion of which does not fall within the province of this article. But I would teach that contour and relief played such an important part in the work, as to entitle them to a fair share of the credit.

The relation of geography to other subjects should be taught. It is not wise to let pupils form the opinion that it stands isolated and alone. On the contrary, they should be led to see that thru it the study of meteorology, botany, and zoology can be approached most intelligently; and that a knowledge of the subject is necessary to a clear understanding of history and sociology. Race and locality are the physical factors in the science of society, and geography deals with locality. It also deals with the conditions which make the productions of the cereals possible, and cereal food is really the basis of civilization.[1]

In short it should be taught that geography is closely con-

[1] Fairbanks.

nected with the material and spiritual interests of man, being one of the principal factors in the promotion of both. Agriculture is the most important occupation of society, and the foundation of all others; and agriculture is determined by the geography of the locality in which it is carried on. Whatever affects it, affects society thru all its ramifications, and touches the interests of each individual man. To teach this will give a significance to the study of geography, that will enable the learners to see that it is worthy of their best efforts.

A word as to the manner in which our subject affects the spiritual interests of man. I am aware that this article is about as long as the law will allow, so I shall be brief. It is generally conceded by leading educators that geography has a high disciplinary value; that as an instrument for strengthening mental faculty it has no superior, unless it be arithmetic.[1] In pursuing the study, sense-perception, memory, imagination, and the reflective powers are exercised and developed. And while it may not be convenient to teach this in all of the classes, the thought should always be in the mind of the teacher.

These are some of the things that should be taught in geography, but they do not exhaust the list.

[1] Harris.

GEOGRAPHY AS A BASIS FOR CORRELATION

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If we compare the number of studies which we, as pupils, pursued in the common schools, with the number which engage the attention of the children of to-day, we see that there has been a remarkable change in the school curriculum.

The old idea was *utility*. Those subjects only were taught which were thought to be of most value in enabling a man to earn his daily bread. To-day the dominant idea in education is *culture*. We aim at an all-sided development. The purpose of our education is not to give the individual the power to provide for future physical needs simply, but to promote the growth of the moral and spiritual life as well. In consequence of this broader view, one subject after another has been added to the course of study, until now we find in addition to the branches formerly taught, music, drawing, modeling, painting, gymnastics, sloyd, domestic science, nature study, etc. That the advent of this new order of things marks an important step in our educational progress and makes for the higher life of our people, few will deny, and yet the fact that teachers are finding it difficult to do satisfactory work along so many different lines, must be faced. If recitations are to be conducted in each separate study every day, the time devoted to each must necessarily be very short and the results attained far from gratifying.

But is it necessary to consider each study as a separate and isolated subject? Is it advisable to do so? What subjects are to be taught, and the method and order of their presentation, must be determined by the motive that animates our educational plan. The aim of education is the development of all of the powers of the individual, to the end that each may approach more nearly to

the ideal of divine manhood. It follows then, that studies should be treated in the manner most conducive to the growth of a symmetrical character. They should be dealt with in their relations to the life of the individual. A fact in history, science, or mathematics is valuable in proportion as it contributes to this upbuilding of character—as it is grasped in its relations to our daily lives. Considered broadly, there is but one study to engage the mind of man, namely that of life, including its environment and its products. Because of the comprehensiveness of this study, we subdivide it and then look upon each division as a separate subject. It is perhaps unnecessary to state that some of these divisions have a greater intrinsic value than have others. Some, more fully than others, lead man to the consideration of his relations to nature and to all life. They are not only educative but ethical. They direct our thoughts to those great truths and laws which constantly operate for the universal good.

The thought, which is the real life of man, strove to find expression in some outward form, and hence arose gesture, speech, picture-writing, drawing, reading, writing, number, etc. This shows us that subjects are naturally divided into two classes—those which pertain *directly* to the life of man and those by means of which that life finds expression. In other words we must recognize content and formal studies. In so far as practicable then, the *demand* for expression should precede the study of its form. Writing is valuable only when we have something to record. Speech is the child, not the parent of thought. The interest which attaches to number lies in its relation to the activities of life. Do not read into my words a meaning which is not there. I do not believe in having each individual begin where the race did. I do not believe in teaching a child to read or spell only those words which he has a demand for at the present time. I am not in favor of keeping from him information with respect to peoples and places of other lands just because the course of study does not call for that particular information at that particular time. I say, in so far as *practicable*, let the forms of expression be studied in connection with the demand for it. Let us recognize the natural relations between subjects and so conserve time, increase interest, intensify thought, and add to the educational value of the work done.

Two chief objections are raised by those who do not believe in

this method of work. It is said that if arithmetic and geography are taken up in a related sense, that comparatively little will be done in either line. Only a smattering of information will be gathered, whereas, if studied as independent subjects, valuable work will be done in each. This, I think, is a mistake. It is not the principle that is at fault; but the method of application. Such an assumption places a greater value upon the length of time devoted to study than upon intensity of thought. It overlooks the great law of association and consequently to a certain degree disregards the element of interest—an element of vital importance in all educational work. We occasionally hear teachers say: "I will never consent to have *my* subject serve as a hand-maiden to another." What answer shall we make to such a statement as this? Are we to regard *subjects* as more sacred than *souls?* It is high time that we gave up this glorification of what we teach, in and of itself, and devoted our energies to the growth of character thru whatever means seems best.

Foremost among the subjects which connect man with the world in which he lives is geography. Because of the universality in the nature of this study, we cannot avoid, if we would, the teaching of facts pertaining to nearly all other lines of work. Therefore, it is the best of "central subjects." But because much of the work in reading, writing, language, number, etc., can best be done in connection with geography it by no means follows that *all* work in these lines should be taken up in this way. It is sometimes assumed that the advocate of correlation believes in going to this unreasonable extreme: That he would not have any arithmetic work done as arithmetic and no language taught as language.

I wish now to suggest a few ways in which geography may serve as a basis for correlation. No subject bears a closer relation to geography, than does history. They are complements of each other. That history teaching which does not make clear the geography of the region in which the events studied took place, contributes little to the life of the student. Col. Parker says: "In teaching history, geography should be used at every step. Before a single fact is taught, the structural geography of the country whose history is to be learned should be thoroly comprehended. The climate, drainage, vegetation, animal life, races of men and all other influences that bear upon civilization should be related to the structure in one great, distinct picture, so that

the social, religious and political acts of men shall pass under the eyes of the pupils upon a real stage, a stage made up of hills, mountains, plains, coasts, rivers, and valleys, upon which the characters of history 'live and move and have their being.' Events are thus permanently fixed in the philosophical memory with the particular stage upon which they were enacted. In addition to this indispensable means of cultivating the philosophical memory, the association of events with structure, climate, etc., leads directly to the investigation of causes, the essential basis of the philosophy of history." At the close of a talk on Asia Minor in which a raised map had been freely used, a young woman said to me: "That is Asia Minor, is it? I have studied about it in history but I never knew just where it was or what it was like." What *did* she know about it?

Prof. Channing says: "The study of history is valuable only as it is a living study; only as the subject conveys to the student something besides mere fact; only as it is interesting. It can be best made interesting by being understood and it can never be understood without a knowledge of the geographical conditions under which man has been obliged to work out his destiny." Courses in geography and history might often run parallel. For example, when the history of the United States is being studied, its geography could be taken up at the same time.

The history of the thirteen colonies can never be a reality unless the student understands the geographical conditions which exerted such a powerful influence upon the lives of the people. The character of the soil, climate, and rivers of the South, and their relations to the occupations and social habits of the settlers, must be made clear. The impoverishment of the soil thru the culture of tobacco and the consequent expansion of the plantations had a marked tendency in shaping the customs and political beliefs of the people.

The importance of the Appalachian Mountains in limiting the distribution of population to the Atlantic Coast Plain for so long a time; the lines of travel followed when the settlers did finally break through this natural barrier; the reasons why the Hudson-Champlain Valley, the Saint Lawrence and the upper Ohio played such a prominent part in the early wars, are geographical considerations which cannot be separated from the historical study of this section.

The difficulties which the Normans experienced in conquering the people of Wales, were due to the structure of that country; and Scottish history would have been very different from what it is, had Scotland been more accessible. The very freedom of England from the many European wars is due to the "silver streak" which separates it from the continent.

The progress of the present war in South Africa can be followed intelligently, and the failure of the English to crush at once the handful of people there, can be understood only as the geography of the country is grasped.

If the history course brings the students in contact with countries the geography of which has not been taken up, then this work must be done by the teacher of history and may therefore be omitted from the course in geography. On the other hand considerable history can be profitably taught in the geography class.

GEOGRAPHY AND READING

Shall we teach reading simply for its own sake. that is for the purpose of training the child in calling words? The object of reading is to acquire and, in the case of oral reading, to express thought. What thought will the child express most intelligently, that which is connected with his experiences and which is consequently of interest to him, or that with which he has had no previous acquaintance whatever? There can be but one answer to this question.

A large part of the labor in connection with teaching the child the mechanical process of reading would be saved if the reading matter were directly connected with his experiences. Leaving out of the question grammatical errors, few adults express themselves as beautifully as do children before they have been taught (?) to read, and this is because they are perfectly natural. If our work in reading were properly done, that same beauty of expression would characterize the speech and reading of later life.

We must discontinue the teaching of reading as an isolated subject and let it come to have a direct bearing upon the work of the day. Geography furnishes an abundance of reading matter both interesting and valuable. If teachers are as careful to correct errors when the child is reading this geographical material as they would be in the reading class, then the pupil is receiving thoro drill in the mechanical side of reading and is at the same time

making real growth. In countless school rooms children are mentally starving for this kind of work. What wonder that they drone and mumble over their reading!

One of the curses of our present educational system is that children are for years subjected to this grind of reading, writing, spelling, language and number work, taught without any reference to the central subjects. We are sacrificing the bodies and souls of our children to this monster, and teachers who believe in a better way should do all in their power to bring it about. Keep this point clearly in mind: I do not undervalue in the least, the worth of these subjects. It is not the subjects against which I protest, but the method of teaching them.

WRITING AND SPELLING

In writing, the objects to be attained are ease, a reasonable degree of rapidity, and legibility. If the teacher will insist upon this in all written work in connection with the various subjects, there will be very little need of burdening the program with writing as a special study.

Much written work can and should be done in geography, and in all of it neatness in execution, as well as the proper position of the writer, should be carefully looked after. This is the rational way in which to teach writing. We all know from actual experience that children very commonly write carefully during the special period devoted to penmanship and carelessly at other times. If we allow this we are tolerating a pernicious habit.

When a new word comes up in the geography class it should be written upon the blackboard so that pupils may then and there see the spelling as well as hear the pronunciation. Demand correct spelling in the papers which are handed in. If they are faulty in this respect, they should be rewritten. When a pupil wishes to use a word which he does not know how to spell, he should be required to look it up. This makes some impression upon the mind. The oral and written work in geography will bring into use a very large list of words and if as before stated, accuracy is insisted upon, we need not be concerned about the use of a spelling book.

LANGUAGE

Much that has been said with respect to reading, writing and spelling applies to language work. No subject furnishes a

wider field for the imagination than does geography. In no study is there a better opportunity or a greater demand for logical work. Cause and effect are handled at every step. I know of no way in which pupils can be given a more thoro, constant, and exacting drill in oral language, than by teaching it in connection with geography. They must say exactly what they mean. Nothing, so far as the language used is concerned, can be left indefinite. Let me illustrate. Call for a definition of a lake, an island, a volcano, a plateau, a geyser or any geographic form which has been studied. Of course I mean by definition, one made by the pupil himself. Require exact statements as to cause of dew, frost or rain, the change of seasons, the building up of an alluvial plain, the importance which attaches to the location of New York, Chicago or Paris. If accuracy in the use of words and clearness in expression are not developed in this way, it is difficult to see how they can be. Papers containing grammatical errors, mispelled words and omissions in punctuation, should be returned to the pupils for correction. If this were done religiously, we should not have so many advanced students "failing" in English and we should not hear them say: "I don't see why mistakes in grammar should count against us in the geography class."

I have tried to suggest a few ways in which geography may serve as a basis for correlation. Space will not permit me to speak of the opportunities of connecting this subject with others than those which I have mentioned. Investigation will show, however, that the teacher of geography should co-operate with the teachers of nature study, arithmetic, drawing, geology, mineralogy, physics, chemistry and biology. Those who are earnestly seeking to place before the children the best possible conditions for growth will find here a broad and profitable field for study.

CONCRETE GEOGRAPHY

BY CHAS. F. KING, MASTER OF DEARBORN SCHOOL, BOSTON

The abstract geography presented in most text-books has done more to dampen all enthusiasm over this study, and to lead to general failure in teaching it than all other causes combined, because such presentation is evidently opposed to the workings of a child's mind. Sully says: "The progress of knowledge is from the individual to the general, or from the concrete to the abstract." Spencer says: "While the old method of presenting truths in the abstract has been falling out of use, there has been a corresponding adoption of the new method of presenting them in the concrete." He strongly approves teaching the concrete before teaching the abstract.

Abstractions and generalizations are naturally uninteresting to children. Why does the child like the story form? Because it is easily understood by him, excites a pleasurable interest in his mind, and has life, motion, individuals, and personality in it. In short, it is concrete. Why does the adult enjoy the novel? Because like the story it is concrete. Why do so few people read regularly the encyclopedia or the dictionary? Because they are so abstract, so condensed, so general. Some reference books are more abstract than others. The difference between Lippincott's latest edition of the *Geographical Gazetteer* and former editions is very marked. The condensation and generalization needed to introduce so many more places has largely destroyed the enjoyment in reading and consulting the book. The newer encyclopedias have no space for interesting details, spicy anecdotes about men, or remarkable statements and comparisons about places. Hence their greater dullness just in proportion to their greater abstractness and abstruseness.

Most of our geographical text-books are small geographical gazetteers and atlases, and that fact should never be forgotten by the teacher. Children can absorb only a very little of this condensed intellectual food at one time. We send our children to the

dictionary for the meaning of one word at a time, to the encyclopedia for one or two facts, but with blind forgetfulness we ask them to gather in one lesson from a geographical encyclopedia fifty facts not closely related in the child's mind. Is it at all wonderful the child fails, or, as a teacher said to me recently, "His facts are in a jumble and he places London in Florida!" Children who begin geography by committing to memory definitions or pages of facts soon to be forgotten rarely develop a liking for the subject. What sad illustrations of this have I not seen among my young friends! On the other hand how many thousands have I not met who were enjoying concrete geography!

There is no better geography than home geography and field lessons; and such is the best kind of concrete geography. In my own school we begin the field-work in the fourth grade, and take the children out during school hours into the streets and near-by parks, and then to the large park two miles away, to study nature, the surface of the earth, the real meaning of geography, and especially to study some twenty type forms such as valleys, hills, brooks, springs and lakes. After a class has seen these forms it can make its own definitions, and they are full of meaning and suggestion. The most astonishing fact connected with field-work is that the children learn so much so easily in one short afternoon, understand it so well, and remember it so long. With equal profit a teacher can well afford to spend needed time in an observational study of her own city or town as a type, taking, perhaps, seven lines of work, viz.: (a) Transportation, (b) Streets, (c) Manufactures, (d) Public Buildings, (e) Stores, (f) Churches and Halls, and (g) Schools. All these topics may be studied together, or they may be assigned to different members of the class.

This home study may be easily followed in the progress of the curriculum by a study of representative cities; as, for instance, London and Greater New York for the largest cities; Paris and Cleveland for beautiful cities; Liverpool and Chicago for commercial centers; Boston and Edinburgh for centers of learning; Rome and Athens for their antiquity; Birmingham, Manchester and Philadelphia for manufacturing centers; Washington and Vienna for charming capitals, etc. The seven points taken up in reference to the home town will be easily applied to each new city by the pupils, or modified to suit the condition. The children are

not only interested in the work, but they are learning how to study, which is more important.

The study in detail of some manufacturing plant situated near the school-house, such as a cotton or woolen mill, a foundry, a bindery or a printing establishment, a saw-mill or even a blacksmith's or a carpenter's shop, will create great enthusiasm and help the children to understand and imagine other kinds of industry as they read about them. The imagination should be more stimulated in the study of geography. Several lessons can be well given to the study of a coal or a silver mine. A few illustrations in books or drawn upon the blackboard will be necessary to enable the children to comprehend the subject. The writer remembers with what pleasure a bright class of boys went into the mining of coal, and the fine, illustrated compositions they prepared on that industry. That concrete study of the subject was worth more to that class than trying to memorize all the coal statistics in the Encyclopedia Britannica, because it truly educated them.

Coal suggests oil, and what a fitting subject to follow. Study its locality, the wells and the machinery from pictures, the pumping or spouting, the piping, transportation, refining and delivery. Then ask the children to reproduce in a composition with illustrations, and give them some fancy titles, as "From the Well to the Lamp," "Pipe Lines," "The Dark Earth and the Lighted Parlor," "How I Came to Your Table," "Kerosene's Autobiography."

A silver coin may suggest to the wide-awake teacher the operations of coining money in the United States mint in Philadelphia; a cup of tea send a class to learn about the growth, cultivation and preparation of tea in the different countries of Asia. Around this one cup of tea may be grouped all that is best to teach the fourth grade about this largest grand division. A cup of coffee may carry teacher and taught to Brazil and South America.

Many geographical details are best and quickest taught thru pictures. Pictorial geography is generally concrete geography and suitable to grammar children—yes, and to teachers, too. The departmental teachers of geography in this school use pictures to a large and ever increasing extent. One teacher has whole sets of pictures illustrating mountains, rivers, valleys and other type forms, enough for each child to have one or more to study, compare and describe in the lesson. Another teacher

supplements her own large collection of mounted pictures by persuading the class to obtain from the library illustrated books of travel. In her room the children can talk by the hour intelligently about the countries they have visited in imagination. One teacher succeeds in interesting her children to make illustrated geographical albums. It is wonderful how these collections grow, how vital and attractive the study becomes as more and more interesting details are learned, and less and less time is found for abstractions.

Another teacher is a great traveler, going afar each summer and always bringing home hundreds of fine photographs for her "pets." Step into the room and see the intense interest aroused when she explains the pictures and relates her personal experiences. This pictorially concrete treatment of the subject perhaps reaches its climax when two hundred children are taken into the hall and shown pictures with the solar camera. Imaginary journeys are taken among land forms, down the Hudson from source to mouth, thru the West, down South, thru Paris and the Alps, up the Nile, thru China, India and Japan. Such work does not seem to be useless because forgotten. The journeys are readily reproduced orally or in writing.

Opening a well known text-book my eye falls at once upon this sentence: "Gloucester and Marblehead are noted for extensive cod and mackerel fisheries." How little the children will get from that statement till teacher and class study the details of the business and learn about the interesting habits of these and other fish: where they live, what they eat, how men succeed in catching them. Is it done by hand lines, or by trawls, or by both? Are they caught near the shore or in deep water, in the North or in the South Atlantic? In salt or in fresh water? What use is made of different parts of the cod? How many million dollars worth of fish is annually taken from the sea? How does this compare in value with the gold taken from the earth? Is the sea one of our important sources of food? Is the crop increasing from year to year, or is it growing gradually less? Have any kinds of sea food greatly diminished lately? Perhaps the teacher will find time after answering these questions to read to the class a chapter from Kipling's "Captains Courageous." What, bring fiction and poetry into the geography? Certainly, as far as there is time. The careful study of this one industry will encourage the children to study

some other occupation, and probably lead to their willingness to do so out of school hours, and thus to the formation of a good habit.

The wide difference between abstract and concrete teaching is illustrated by the various methods of teaching mathematical geography. The common abstract method of trying to make the children commit to memory the statements upon the printed page in reference to this subject is usually a wearisome failure. How different the result when the teacher bases the teaching upon the globe, and requires every child to have one in his hand. Or the still much better method of observing nature, the movements of the moon, the sun, the Great Bear, etc., as set forth in Miss Bowen's "Observational Astronomy for High Schools," the simplest part of which is well adapted for the upper classes in grammar grades.

The various geographical readers, with their full details, abundant, and in most cases, excellent illustrations, present geography in an ideal concrete way. In the personally conducted journey this method approaches closely to the real journey and has great value. Many experiments and tests with different readers and different grades have proved beyond question three points: the clear understanding of the subject presented by words and illustrations, the great interest easily aroused, and the remarkable power to reproduce what was read and seen in these books. No such success follows in reading the ordinary text-book, because the style is too abstract.

In closing allow me to utter a caution: Show common sense in all this concrete work. Do not attempt to study Paris concretely and to such an extent that you not only study the city as it is to-day, but attempt to weave into the study much of its past history, its stand in art, music and the drama; its literature and science. If you take an imaginary journey about Rome, remember the time limit and leave a few points for your children to learn later in life. All the suggestions made in this paper are to be modified by the amount of time at one's disposal, and by requirements in courses of study. Some of them can be carried out by every teacher: all of them by only a few. Model lessons in concrete geography may appear in later issues.

THE POINTS OF THE COMPASS, AND THE SEASONS, IN TEACHING GEOGRAPHY IN THE GRADES

BY JOHN M. HOLZINGER, STATE NORMAL SCHOOL, WINONA, MINN.

The educational discussions of the past decade are characterized by the strong emphasis which they place upon the fundamental principles of imparting knowledge to the young. In this way has come to the foreground the advocacy of the habitual observation of Nature, its objects and phenomena, largely with a view to aid the thinking to render comprehensible and give meaning to abstract data involved in their studies. The teacher is made constantly aware that his function is rather to draw out the observing powers and the reasoning faculty of the children than to cram them full of ready-made intellectual mince pies and cakes.

This attitude of the teacher is especially desirable in the subject of elementary geography. A composite rather than a simple study, like arithmetic, it has in these latter days taken on bits of subject matter more or less closely germane to its own genius, from various and widely different fields of study. And so overlaid and incrusted is it by these accretions of advancing civilization that the teacher who successfully guards against indiscriminate memorizing of unintelligible data in one direction or other must be a miracle indeed. The efforts put forth in this field by King, Tarr, Redway, Frye, McCormick, Trotter, and others, in recent years to make reasonable and give the right direction to this study are not bearing fruit as universally as one might desire. And one finds good reason for hesitating to enlarge upon any of the numerous suggestions already made, and to venture upon new ones. I feel like humbly apologizing for offering some remarks on the subject of this paper, conscious that I am confronted by a veritable wall of inherited conventionalities.

First, then, as regards the points of the compass. There is no reason for supposing that both teachers and pupils in the grades fail in developing fairly intelligent notions on this matter. East is, in a general way, the direction in which the sun rises; west,

that in which it sets; and so on. In many of our cities, and in most rural districts, the problem is simplified by the streets and fences, running north and south, and east and west; I should say, *apparently simplified*, by such accessory aid. For unfortunately these accidental aids make it possible to avoid going to the bottom of the problem. And the moment the young geographer is placed in new surroundings, with no streets and fences to aid, he is absolutely at a loss to orient himself. How often have I had to hear, both from visitors and students: "I am all turned around! What you say is west, seems north to me!" They remember that their map shows the Mississippi river running in a general direction southward, whereas near Winona it holds for several miles an almost due easterly course. All such accidental aids to get one's bearings are manifestly inadequate and delusive. I am perfectly willing to let geography stand as the study of the earth as the abode of man; there is just a suspicion that our children, after studying this subject for eight years, more or less, are still deplorably helpless when required to find their way about on this "abode."

I am sure all teachers are aware of the real necessity of the case. And doubtless we each have done our duty—have *theoretically* shown that north is in the direction of the north star. But a theoretical, that is, a verbal statement, avails as little for the actual needs of the case as a verbal statement of how to swim helps a drowning man to save his life.

What is needed is, not a lot of fairy stories about Polaris, Arcturus, Cassiopeia and all the notables and mythical deities whose names are perpetuated among the stars; but some simple, effective plan of engaging the attention of the young on the most palpable phenomena of the nightly heavens. And this not for an evening or two, sporadically; but systematically, for a period of years. For the younger children, I would restrict the observations to the north star, Polaris, and what goes on around it, especially the movements of the Big Dipper. Within the United States above forty degrees north latitude, these northern objects are visible every clear evening, and deserve to be observed systematically by young and old.

This fixing of the attention upon the north star is a logical necessity for another reason: Most maps of the earth's surface have the north point at the top; that is, the map-maker, while

drawing his maps, imagines himself facing toward Polaris. And this star has served as a geographical land-mark, or rather "sky-mark," to all nations north of the equator from the very dawn of history.

The north star is thus the only satisfactory, because the only fundamental, starting point for determining direction. And we cannot begin too early teaching children to observe it. For elementary purposes we may at first ignore the fact that it does not mark the exact point of the north pole of the heavens, being a little over a degree out of place. The point to be sought with the children is, to induce them to observe Polaris and the Big Dipper at their several homes, taking a few minutes on all cloudless evenings, both early and late, in noting what is going on. In the more vigorous climate of our northern states these efforts may best be confined to the milder fall and spring months; yet, after the habit is once formed, a snappy zero temperature is as alluring as the balmy summer night air.

Every teacher needs to have a way of his own in endeavoring to accomplish a certain end. And I trust I am not thought presumptuous in offering to present my way of getting at the problem in hand. A beginning is made by placing on the blackboard a correct diagram of Polaris and the Big Dipper. The ratios of the distances are studied, and are sought out again in the sky. The children are aided in this by copying the diagram as carefully as possible on some heavy manilla paper. I consider this preferable to distributing uniform copies. After they have studied these stars for some evenings, the matter is called up on the morning after a clear night, at the beginning of the geography lesson. Questions, such as how the distances should be measured, soon are raised, and must be answered according to the degree of geometrical preparation of the children. Some will put on the blackboard the diagram as they saw it the evening before. They are led to represent by a straight line below the diagram the part of the horizon circle which is in the field of vision as they face these stars, and then to label each diagram thus: "Looking north at 8 p. m., Sept. 5," etc.

In the course of the observations during the first fall, during which the children should be led to draw the stars of this first diagram in their relation to the horizon, at different hours of the same evening, repeating the task after a month, or later still, it

will gradually become clear to them that the stars, while "fixed" with relation to each other, have a way of each night swinging around Polaris; and that there is also a shifting, a nightly *westering* of the stars, which, though slight in one twenty-four hours, becomes graphically apparent after a month or two. The latter point is more clearly understood by including in these first observations the Chair of Cassiopeia. It is thus clear that these simple efforts at the study of ever present Nature furnish valuable, and, in my judgment, indispensable data for a concrete understanding, later on, of the earth's rotation and revolution.

Then, in the next place, the efforts at teaching the essential facts of the seasons, and the attendant behavior of the sun thru a period of twelve months, by geometric diagrams and simple mathematical computations, without so much as a suggestion of outdoor observations to accompany, not to say precede by years, and to help understand and make real these perennial facts of interest in our every human life, has always impressed me as a pitiful shadow and excuse for what ought to be, and might easily be, given to children on this subject. A more concrete foundation for this phase of geographical study is the more important since it is intimately and logically connected with the trades and anti-trades, the "roaring forties," the belt of calms, and the periodic shifting of these areas, as well as with storms and cyclones. Without a concrete connection with the ever present appearances of the sun's varying behavior, observable by every child, the lessons on these topics must necessarily be lame and mechanical, and when recited at all they cannot be more than repetitions of text-book statements faithfully enough memorized, but without any vitalizing content.

The basis on which a right understanding of the seasons, or, to state it more comprehensively, of the annual course of the sun and all the attendant terrestrial phenomena, can be built up in children, it seems to me, must include some knowledge, and that *only* and exclusively from observation, of the sun's annual path. Even younger children can be led to see, say, by the shadow on an improvised sun-dial, how low the mid-day sun is in December (in latitude 43-45 degrees), how it rises far to the south-east and sets to the south-west, and how it rises and sets farther south of east and west, the farther north our place of observation is, until it just touches the southern horizon on the arctic circle at midday; then, how high it rides in June, rising far in the north-east and setting

in the north-west, swinging farther and farther north as our place of observation is moved north, until we reach the arctic circle, where at midnight the sun remains at that time, hovering just on the north point of the horizon. A right understanding of the cardinal dates is one of the *necessary* incidentals in the discussion of the seasons. But if the younger children can be led to make simple observations on the relation of the sun to our horizon, the children of the upper grammar grades, those of twelve to fifteen years of age, certainly can go a little farther, and trace the annual path of the sun across the heavens. To this end I have found it helpful to lead by a few diagrams of stars, which are readily understood, to the observation of the phenomena along the line of the ecliptic—the line where the plane of the ecliptic cuts the starry vault. These phenomena include the planets, the moon, and, *by inference*, the sun. By calling for the data observed on the average once a week during the fall quarter, which allows for the interferences by cloudy weather, the ground indicated in the twelve diagrams appended, may be covered. It should be reviewed from season to season. The geometric figures showing the star relations in each case need to be given before hand, one or two at a time, and copied by each child. Guided by these, each will trace the necessary star groups independently. It is expressly desired that only those stars and star groups be looked for and located which aid in tracing the ecliptic. Since we start with the circumpolar groups studied before, it is arranged that each diagram involves two known points to which a point to be next looked for is added. (In one or two cases several simple diagrams have been combined to save space.) They afford a very mechanical illustration of the principle of passing by steps from the known to the unknown. The legends and explanations with the diagrams, it is hoped, are sufficient to make the latter intelligible to all interested. Similar diagrams may be devised for this form of nature study—for this is what it is intended for—in continuing the study of the ecliptic and the progress of the sun in it thru the winter, and especially the spring months. It will be observed that eight of the twelve constellations of the zodiac are located by the accompanying diagrams, leaving only Cancer, Leo, Virgo and Libra to be found.

In closing I feel constrained to refer to an objection that has been raised to the effect that this involves too much astronomy—

that it is astronomy rather than geography. The fact is, whatever you may call it, it is all matter always directly before the eyes, and matter so absolutely easy and simple that every child may and should become thoroly familiar with it by the time he or she is a candidate for the High School. Let me state it clearly that the effort to be made is not, to study and know the stars comprehensively, but simply to become familiar with a few prominent "mile posts" so to speak, to place ourselves in a position to adequately comprehend the relation of the sun to our planet and our daily life. Much of course is still left for the scientific imagination to fill out: how it is actually the earth that rotates, that revolves, and not the starry heavens, not the sun; how the plane of our horizon sweeps on thru space, leaving us Polaris as a perennial guiding star; how this horizon plane is tangent to the sphere of the earth wherever the observer stands: how the sun's rays at any point of time strike the horizon plane more obliquely the farther from the equator the observer moves; how the sun's rays at the time of the summer solstice illumine all the area within the arctic circle for an entire twenty-four hours; how the north pole, the center of this circular area, is illumined for six months, while at the same time the south pole has six months of continuous darkness; how the sun appears to move in the space of twelve months to people on the equator, on the tropics, within the arctic circle; etc. And it is this use of the imagination that has seemed to me to be most worthy of cultivation. No, the exercises suggested are too meagre to be called astronomy, are intended simply as an aid to right geographical concepts, are in fact believed to be indispensable for such concepts, but are also, it must be admitted, fully as indispensable in forming astronomical concepts, which cannot possibly be held as an objection to their use in geography.

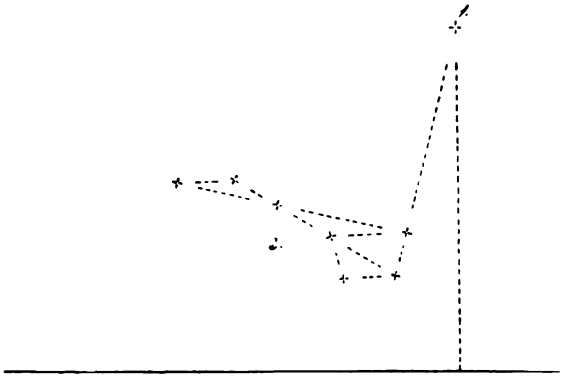
NOTE—For the benefit of teachers desiring to work out this matter further I wish to say that the best aid to me has been for years Burritt's "Geography of the Heavens," both text and atlas, Peck's "Constellations and How to Find Them," Miss Eliza Bowen's "Astromony by Observation," and Jackson's "Astronomical Geography." But over and above all, each teacher must, under the stress of his own individuality, select the simplest and easiest points for instructing the children.

LEGEND TO DIAGRAMS I TO XII

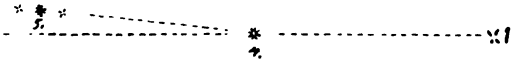
1. Polaris.
2. The Big Dipper, including seven stars.
3. Arcturus, in the constellation Bootes.
4. Vega, in the constellation Lyra.
5. Altair, in the constellation Aquila.
6. The star group of the Northern Cross, in Cygnus.
7. The two (three) stars in the constellation Capricornus.
8. The Inverted Dipper in the constellation Sagittarius.
9. Antares, in the constellation Scorpio.
10. The position of Saturn in the fall of 1899.
11. The Chair of Cassiopeia.
12. The Square of Pegasus: *a*, Algenib; *b*, Markab; *c*, Scheat; *d*, Alpheratz.
13. The brightest star in the constellation Perseus, named, like *a* in Pegasus, Algenib.
14. Algol, in the head of Medusa.
15. Almaack, in the foot of Andromeda.
16. Merach, another bright star in Andromeda.
17. The Pentagon, in the constellation Pisces.
18. The Y, in the constellation Aquarius.
19. Capella, the first magnitude star in the constellation Auriga.
20. Star group in the constellation Aries.
21. The Pleiades, in the constellation Taurus.
22. Aldebaran, the star of the first magnitude, in Taurus.
23. Castor, in the constellation Gemini.
24. Pollux, the other of the Twins, in Gemini.
25. The little star Tejat, which marks very nearly the summer solsticial point.
26. Bellatrix, the first magnitude star in west shoulder of Orion.
27. Betelguese, the first magnitude star in the east shoulder of Orion.
28. Rigel, the third star of the first magnitude in the left foot of Orion.
29. The three stars in the belt of Orion, also called the yard stick, because they extend over three degrees of an arc.

EXPLANATIONS OF DIAGRAMS

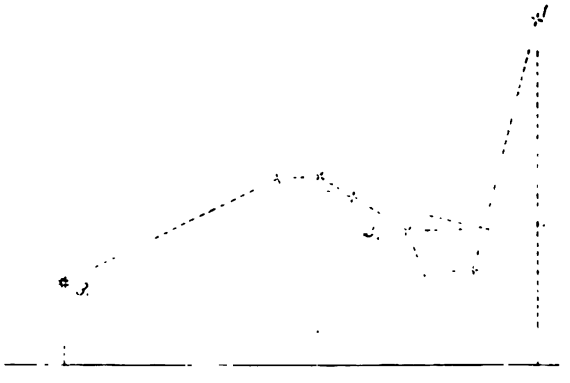
NOTE:—The line at the base of each diagram, when drawn, represents the part of the horizon circle conceived to be in view at the time of looking at the star group indicated. These diagrams are selected from work done by students, and are only approximately accurate. For their preparation I am indebted to Miss Alice Brown and Miss Anna Clausen.



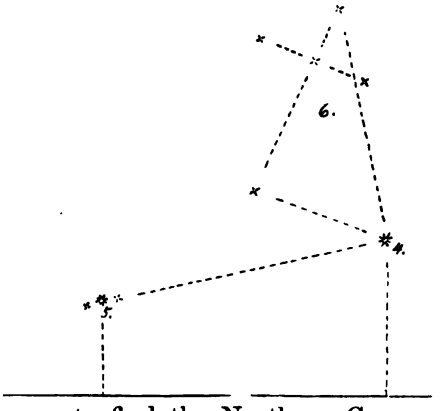
I Polaris and the Big Dipper, the starting point. Look north and west at 8 p. m., September 12.



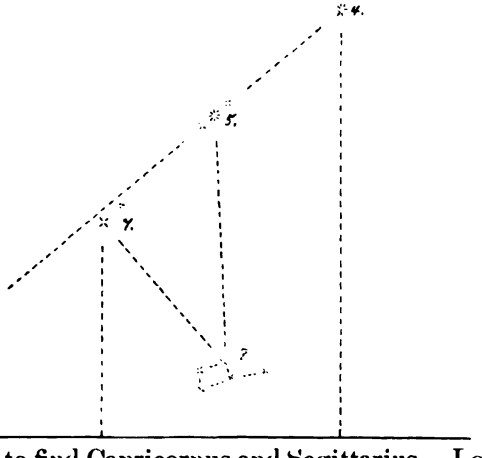
II. Diagram to find Vega and Altair: Face west, looking nearly overhead, at 8 p. m., September 10. (Vega is then the only bright star near the Zenith.)



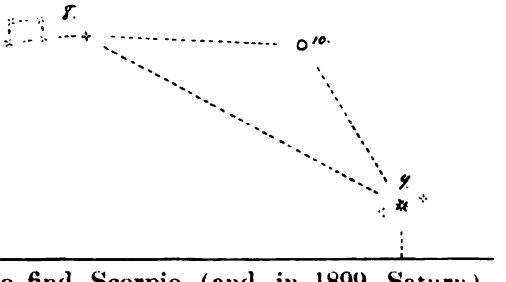
III. Diagram to find Arcturus. Look west of north at 8 p. m., September 10.



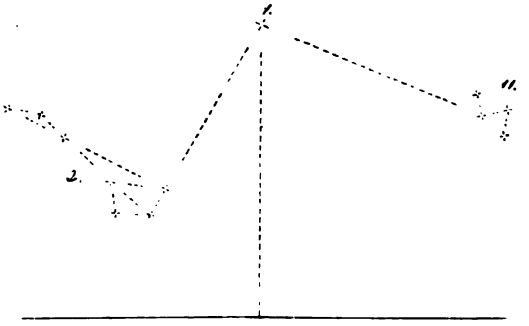
IV. Diagram to find the Northern Cross. Look west at 10 p. m., November 4.



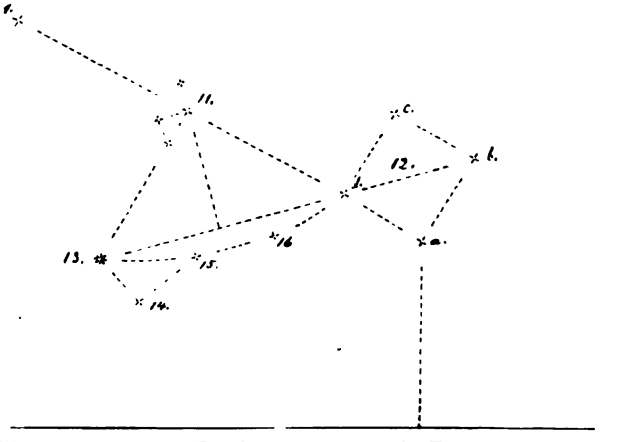
V. Diagram to find Capricornus and Sagittarius. Look south-west at 8:30 p. m., September 10.



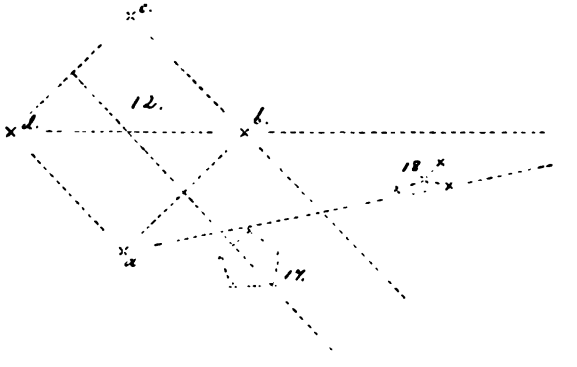
VI Diagram to find Scorpio (and, in 1899, Saturn) Look south-west at 8 p. m., September 10.



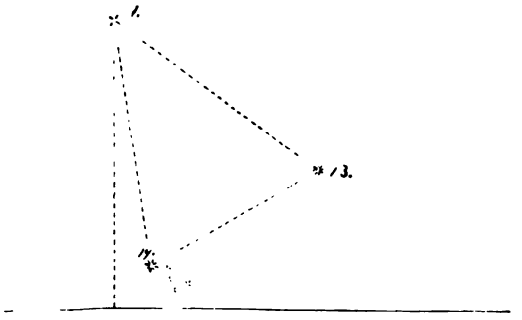
VII. Diagram to find the Chair of Cassiopeia. Look north at 8 p. m., September 10.



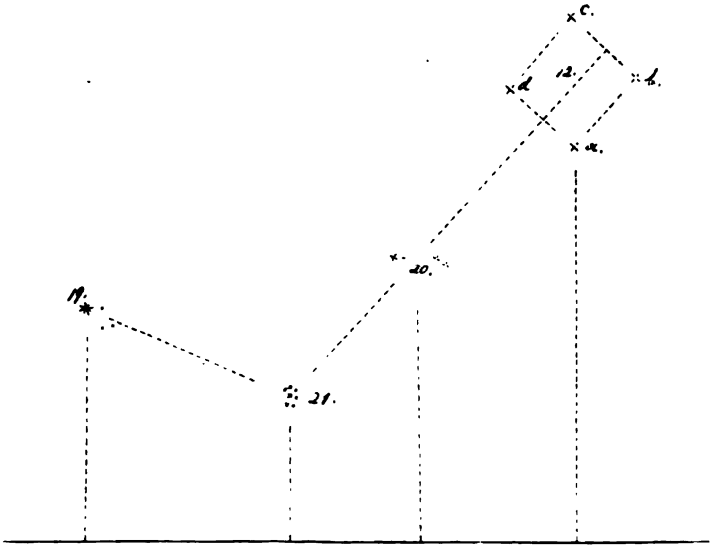
VIII. Diagram to find the Square of Pegasus, Andromeda, Perseus. Look north and east at 9 p. m., November 2.



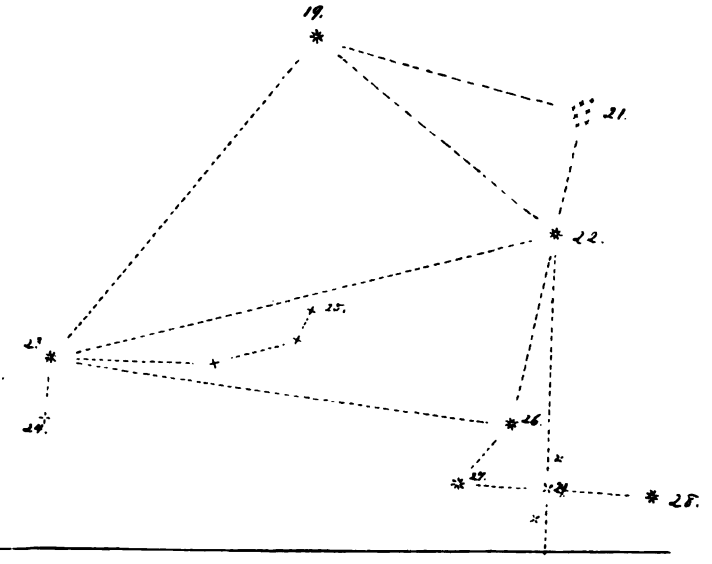
IX. Diagram to find Aquarius and Pisces. Look east at 9 p. m., November 2



X. Diagram to find Capella and Perseus. Look east of north 9 p. m., November 2.



XI. Diagram to find Aries and Taurus. Look east at 7 p. m., November 2.



XII. Diagram to find Gemini and Orion. Look east at 10 p. m., November 4.

PHYSIOGRAPHY IN THE SCHOOLS

BY GEORGE L. COLLIE, BELOIT COLLEGE, BELOIT, WIS.

Physiography is a term which has crept into common use within the last few years, but unfortunately with very varied meanings. If the question should be put to a body of geographers, "What is physiography?" many different answers would be heard. Some consider this subject to be broad in its scope, and to include within its province the description of nature as a whole. Others regard it as synonymous with physical geography, as that subject is generally understood, while others would still further restrict the province of physiography to the description of the land forms of the earth. There is much to be said in favor of the latter view, tho it is one which is held, as yet, only by a few geographers.

There are three envelopes of the earth to be studied: the hydrosphere, the atmosphere, and the lithosphere. Physical geography is ambitious enough to include each and all within its borders, tho each envelope has been erected into a distinct study

by itself, each one demanding special treatment and careful preparation on the part of the teacher. The lithosphere, much more complicated than the other envelopes, is confined to one study—geology. It is true that geology is now divided into several parts, each of which is worthy of study by itself; but it is painfully apparent, even to this day, that each author who considers himself called upon to write a text-book on geology, feels that he must combine all of these several parts into one whole, and compress them between the covers of one book. There is great need of differentiation in a comprehensive subject like geology, and there is no better place to begin than with the surface features of the earth, which are naturally well differentiated from the rest of the subject. Surely if the atmosphere is worthy of special study by itself, the surface of the earth is worthy of special treatment by itself. If the need of this differentiation is granted, then there must be a title for this new study. The writer believes that this should be physiography.

Many will at once object and urge the prior claims of physical geography as the true title for a subject which deals with the surface features of the earth. There are objections to this use. In the first place physical geography does not confine itself to the earth's surface; it soars in the air and plunges into the ocean; it hobnobs with all living things on the globe. In the second place, physical geography, when it does deal with the surface, confines itself to the present aspect of the surface; it deals with the present activities of the globe, and with the present result of those activities. Physiography, in the sense in which the term is used here, goes back of the present and seeks to find out all of those changes which have affected the surface of the earth from the beginning to the present day. Physiography is an historical study; physical geography is not, and to wrench it from its prevalent use is a violation of well established usage. It is far better to erect a new study, an historical physical geography, and give it a new name, Physiography, if you please.

Taking this position in regard to the subject, it is in order now to define our subject, and to enter into a discussion of its province in educational matters. Physiography is the science which deals with the surface features of the earth. It describes their form and structure; it enters into the question of their origin and their subsequent history. In addition to all this, physi-

ography is coming to have an important meaning in connection with the surface of the earth as the physical environment of man. It treats, in a special way, of those physical features which one should know in order to understand the relation of the earth to man. It will be seen that with such a field of action, physiography is no mean study; it is, in fact, already a complex and difficult one. No teacher should approach the study unless he is well equipped for its proper presentation. The foundation of physiography, as a study, is a thoro knowledge of the rocks which make up the crust of the earth. This includes their origin. composition and structure. Without this intimate knowledge of rocks and their structures, teachers cannot hope to present an adequate idea of physiography to their pupils. In this matter physiography invades the domain of geology proper, but it is necessary that it should do this. Not only must teachers possess this knowledge of rocks, but they must be able to impart their knowledge to students, where, as in so many instances, the text-book fails to give an adequate presentation. In addition to this requisite knowledge of rocks, there are other fundamental matters which teachers should have in mind, and which they should impart to their pupils at an early stage in the study of physiography. It would be better to give these fundamentals categorically rather than to allow pupils to get them by chance or possibly not to get them at all from their study of the text.

One of the best known of American physiographers has recently issued a text-book, which is apparently based on the supposition that pupils are to get fundamental ideas inductively, after a part or a whole of the ground has been covered. The method is an admirable one, no doubt, but it is a fair question whether the mastery of such fundamentals should be left to the chance of the inductive method. Many matters may be left to that slow process, but not all by any means. Students are not apt to get the foundation facts in time to make the largest and best use of them. These fundamental facts of physiography, which in the experience of the writer need to be understood by teacher and pupil alike at the outset of their study of this subject are five in number.

In the first place, some understanding of the length of geological time is necessary. The period during which the earth's surface has been brought to its existing conditions is exceedingly long.

No one gets a true conception of physiography who does not consider the enormous length of the time in which the earth has existed and in which these changes have been taking place upon the surface. This time is not measured by the ordinary standards of human history, but rather by the tens of thousands and hundreds of thousands of years. It is a difficult matter for teachers to impart this notion to young minds, but care and skill will accomplish the desired end, and with it a much better understanding of the relationship of all topography, in time, to our day.

The second fact which needs emphasis is that the existing surface of the earth has not always had its present aspect. Each surface feature, each hill, each valley has had a beginning, in some cases a recent one, geologically speaking, in others an ancient one; but all have had this beginning. So much is said in literature about the eternal hills, and our common experience so convinces us that the features about us are unchangeable, that we unconsciously fall into the habit of regarding the surrounding topography not only eternal as regards the future, but as existing from the beginning of the world. This notion should be eradicated at the outset of the study of the earth's surface.

The third fact which should be understood by the pupil beginning physiography is that the surface features of the globe pass thru a cycle of development. In their beginning they had different features from those they now possess; they have changed from time to time, and even now they are changing in that slow, deliberate fashion so characteristic of nature. The modern theory of evolution applies not only to plant and animal life, but to the topography of the globe as well, of course not always in the orderly and stated way that characterizes organic development, but yet in a way that can be termed development. It is necessary early in the study of physiography to impress this idea upon the student's mind – the idea of progressive change from youth to adolescence, maturity, and old age. These stages in the cycle of development should be presented as the ideal history of every form on the earth's surface. At the same time it should be stated as possible, if not probable, that the cycle cannot be completed on account of accidents. These facts do not need elaboration until they come in regular order in the study, but they should be stated.

Another fact that is important to understand in the beginning of a pupil's study of physiography is the circulation of material

on the globe. There is a constant transfer of material from the land to the sea, as is well known. Soil and loose debris of all kinds are on their way to the sea; when the sea is reached and the material buried, it may be returned to the surface by elevation, and begin anew its journey, its endless round of travel. In a similar way water is in constant circulation. It falls to the ground, sinks into the earth, is returned thru springs, or is driven back by volcanic action; it flows to the sea and is returned to the earth thru the medium of the clouds. All solid, liquid, and gaseous matter is in this state of circulation. Pupils should understand this, since it is an important factor in physiographic study.

Again, it is necessary to impress upon the mind of the beginner, the essential instability of the crust. It is in constant movement, and the nature and variety of these movements should be understood, such as the earth tremors, pulsations, seismic movements, and orogenic and epirogenic movements. The constant activity of chemical and physical forces within the crust should be touched upon. Thru these activities the rocks of the crust are being rearranged, recrystalized and made over into new forms. The common idea of the crust is that it is a dead, inert mass of matter, where no change ever takes place. This idea should not be allowed to remain in any pupil's mind; rather the true conception should be introduced early, that the crust is a great laboratory in which there are continued physical and chemical changes going on. Mention should be made of the factors that offset the instability of the crust, such as erosion which tends to cut down the rising land, or deposition which tends to fill up the depressions caused by down-sinking. As a result of the interaction between these opposing activities topography arises. These somewhat fundamental facts, that have been stated above, should be impressed upon the pupil's mind early in the course. This can be done best by simple talks at the outset; no great elaboration is necessary at first, indeed, that is not advisable, simply a plain statement of the facts. It is not necessary to give the why and the wherefore in each case; that may be safely left to the future study and discussion of the subject.

When these matters are understood, the way is open to the study of physiography with some understanding as the basis of the work. Much laboratory work of a simple type can be used

profitably, especially in establishing the necessary knowledge of rocks as the foundation of physiography. In most regions of the north, at least, it is possible for the observing teacher to pick up materials that will suffice for laboratory work; these materials may be found in the immediate neighborhood of the school. Specimens of this sort are better than cabinet specimens, since they are more typical of common occurrences. These specimens should be used in the laboratory to show the differences between the igneous and clastic rocks, especially in their structural characters. A few hand specimens of rocks, which typify the principal members of the rock family, will make all of the difference in the world, in the understanding of the structure and origin of the crust, on the part of pupils. It is always possible to obtain rocks which show the important features due to subsequent changes, such as jointing, cleavage and schistosity. These structural features have so important a bearing on the subsequent weathering of the rock, that they should be well understood and illustrated.

The kinds and degrees of weathering can be illustrated quite fully by specimens picked up in the neighborhood of the school. It is remarkable how readily physiography lends itself to laboratory methods, provided the teacher takes a little forethought and pains in providing the material, which lies all about. There is no science study, in the schools, which can compare with physiography in the wealth of illustrative material on all sides. It can be had for little or nothing, in marked contrast to the expensive materials required for chemical and physical laboratories. In connection with the subject of weathering, much attention should be paid to the soils, not only in laboratory study, but also in field study, from the economic standpoint. Structure and composition of soils may be studied with a view to their bearing on tillage and fertility. None of this work should be anything but simple and elementary in character, yet great results arise from work of this kind; it gives new insight into the methods of nature and a better understanding of all the processes by which the present aspect of the world has been brought about. The teacher is an interpreter of nature to the pupil; and it is remarkable how much can be accomplished by a careful teacher, by opening the eyes of the pupils to the physical world about them as it is represented in topography. How much interest is added to a boy's life, for all time, if he has some understanding of the origin of the hills that line the horizon; if he has

some conception of the activities of the stream that flows thru the meadow; if he knows something about the soil which he cultivates. I am convinced that there is no study in the school curriculum that adds so much to the pleasure and understanding of young people as that of physiography. Maps and models are very useful adjuncts to a teacher's work, when the land forms are taken up. But they are not absolutely necessary if the teacher has the good sense to make use of the natural models, which may be found in every region, worked out by nature itself. The activities which are of chief importance in making land forms can be studied in every community: the work of wind, of running water, of standing water. It is also possible to study the typical forms resulting from these activities. Often these forms are on a small scale, but they are typical of the larger types. Glaciers and mountain building agencies are the only important makers of topography which cannot be studied at first hand in most country communities. No greater obstacle than a teacher's indifference or lack of preparation stands in the way of presenting the subject of physiography adequately and fully in any schools within the confines of the Mississippi valley, and that too with abundant illustrative material outside of models and maps.

As already stated, physiography has an important bearing upon a person's education. It also has had for ages an important bearing upon the temperament and character of man, unconscious tho that influence may have been. The physical surroundings of man have helped to determine his character. It has in a marked degree influenced the works of man, determining where he should build his cities, lay out his roads and other public works. It has determined what his occupation should be in any particular locality. In addition to this, topography has had a powerful influence upon the literature of man; this is especially noticeable in the case of Scotch and Scandinavian writers. It has determined what the trend and character of history should be. Great mountain barriers, for instance, have separated nations so that they grew to be populous and powerful and yet ignorant one of the other, uninfluenced by each others customs and civilizations. This condition of affairs has been true, especially in the past, before modern improvements made it possible to overcome these natural obstacles. In the minor matters of life it is becoming more and more important to understand topography and its effects

on our lives. The farmer can do better work if he takes advantage of the slopes in draining the farm, if he watches them to prevent the erosion which naturally takes place on their surfaces. The health of the household is often dependent upon the location of the home, and the character of the surrounding topography. From various points of view it is becoming necessary to study physiography in the schools, not alone for its own sake, but for the purpose of finding out how it affects man's welfare, how it determines his history and civilization.

THE USE OF PHYSIOGRAPHY IN GEOGRAPHY STUDY

BY RALPH S. TARR, CORNELL UNIVERSITY, ITHACA, N. Y.

Accepting the current definition of geography to be "a study of the earth as the home of man," we have two elements in the study, the earth and man. By some the mistake is made of attempting to consider one or the other, or more often both together, but without their proper relation. On the one extreme, the study is led toward pure physiography, which is properly a branch of geology, on the other extreme toward the study of sociology, or history, or some other branch of the study of man. Properly handled, however, neither aspect of geography should be studied for itself, but solely with reference to the *relation* of earth and man. This calls for much judgment as to the extent to which one is warranted in encroaching upon neighboring fields of knowledge. However, any point in physiography, in sociology, or in history, which illuminates a point in the relation of man to the earth may be drawn upon.

Of late, especially since the report of the Committee of Ten, there has been a strong tendency among geography workers toward the utilization of physiography in geography study; and while, in many instances this has without question been carried to an extreme, on the whole the movement seems rational, well founded, and scientific. If we are to have a study of the earth as the home of man, we must by all means have some familiarity with the earth. I do not believe that the teacher of geography has any right to treat of young, mature and old valleys; nor of the destruction of lakes by filling; nor any other purely physiographic principle or phenomenon for the sake of the thing itself. Fortunately

abundant use of physiography may be made without diverging from the true path of geography study; and it is the object of this paper to illustrate the relationship of physiography to geography, as I understand it. To do this, it seems best, perhaps, to take a few specific illustrations.

For instance, let us consider the geographic topic of lumbering in Maine. There are two directions here, as in most other topics of geography, in which one may work. In the one case he may look back for the causes which have determined this particular industry; in the other he may look toward the results of this industry. The former usually leads to an inquiry of a physiographic nature; the latter leads in most instances toward political and commercial results, together with certain historical and sociological aspects of geography. It is the former in its distinct effect upon the latter that I would consider in this instance.

The surface of Maine is mountainous, not rugged in the sense that the Andes and Alps are, but rather smoothly rounded. The reason for this is that Maine is an old mountain land long exposed to the air, and much worn, having lost the ruggedness which the younger Alps and Andes still possess. If one's interest in physiography were sufficiently great, he might carry this casual notion much farther than has been given here, tho the danger then comes of making the study geological. For geography study, enough has been done when the principle above stated has been appreciated.

The surface of the old mountain region of Maine, while not rugged, is, nevertheless, rocky, and barren of soil. The cause for this is the advent of the great glacier which spread over northeastern America. Here, again, the extent to which the study of glaciers should be carried in a geography class may vary with the teacher; but no teacher can instruct properly in the geography of northeastern America who neglects a consideration of the effects of the glacial period. Again and again this impossibility is apparent. My own idea is that there should not be too much study of glaciers—possibly a comparison between the conditions now existing in Greenland, and those formerly existing in our northeastern country, showing how they form, advance, scrape off the loose soil, and deposit other in its place. It should also be pointed out that Maine, being a hilly country of hard rock—old mountain cores—had a thin and rocky soil left, while the more level sections,

where the rocks were softer, have a better soil, as in central New York.

Under these conditions Maine has been permitted to retain much of its forest cover, while from many other portions of the east the timber has been removed to make room for more profitable industries, such as farming, manufacturing, etc. Such being the case, lumbering is one of the greatest industries of the state; and still another industry of marked importance in Maine also depends upon the forested condition, namely, the hunting and fishing, which attract thousands every year, furnish employment for thousands of people, and bring hundreds of thousands of dollars into the state.

The mode of removal of the timber depends upon the topography and the climate. The high latitude and the hilly condition determine that in this section there shall be a heavy snowfall and much cold weather in winter. This makes lumbering feasible by leveling the surface of the ground and freezing the swamps and lakes, when the lumbermen may move freely about with their teams. The rapid melting of the snow in spring causes the streams to rise in flood, so that the lumber may be drifted down toward the market. On its way, some is held to be worked into various forms of lumber at the local saw mills, each situated at some point in the stream, where the effect of the glacier has caused a rapid or a fall; but much is carried on as far down as the current will bear it, namely, to the very point where the rising tide checks the onward flow of the river water. Since the greater part of the lumber must be used outside of the sparsely settled state, such places are naturally the ones where the greatest work of changing the rough timber and removing the surplus portions is performed. Hence, the location of such cities as Bangor, with its immense saw mills, paper mills, and lumber shipping business.

Here comes another application of physiography. Coast-lines rise and fall, some being even now engaged in an upward or a downward movement. The latest oscillation of the northeastern coast of America has been downward, partially drowning the land. This has admitted the ocean water far up the river valleys, and caused the irregular coast of Maine, almost fjord-like in nature, and quite in contrast to the irregular but low coast of Chesapeake Bay where the rocks are soft instead of hard as are the old mountain rocks of which Maine is made. This has determined the

existence of innumerable excellent harbors, by far more than a state so sparsely settled as Maine has need for. It has permitted the location of the lumber cities at the head of navigation of the streams, as well as many smaller towns and villages from which a few fishing vessels venture out upon the ocean. The irregular coast, with its many harbors and its abundant fishing grounds, together with the great supply of lumber, caused Maine to become noted in the early days not only for its fishing but also for its ship-building. The hard rocks, the numerous harbors, and the available ships have determined the shore industries of the Maine coast.

This, in brief, is a suggestion of the use to which physiography may be put in explaining the relation of the earth to man. It tells not merely the *facts* of importance, but the *reasons* as well, and should help in geography study by introducing the element of interest—an element which in much geography work is sadly lacking. To do it properly, the teacher must have some familiarity with physiography; but he does not need to be a specialist in the subject.

Of another kind, the following may serve as an illustration—a chain of cities extends from Trenton, New Jersey, into Alabama, including Trenton, Philadelphia, Baltimore, Washington, Richmond, Raleigh, Macon and others. These are all upon rivers, and all near the boundary line between the level coastal plains with their soft rock layers, and the harder rocks of the ancient and much worn mountains, which now form a series of low hills known under the name of the Piedmont plateau. In descending from these hard rocks to the softer layers of the coastal plains, the river waters have found it possible to excavate their channels more deeply into the soft than into the hard rock, thus forming a series of rapids and falls near the boundary line, which, in fact, is known as the *Fall Line*. Nearly up to these falls, in the case of such cities as Philadelphia, Baltimore, and Washington, ocean vessels are able to pass because the subsidence of the land has admitted the sea into the lower portions of the valleys, now partially drowned. Naturally, therefore, at these points, the farthest inland to which vessels are able to reach, cities have developed, as, in fact, was the case with the Indian towns before white men came.

A combination of physiographic features has determined the

location and importance of the chain of great cities from New York to Duluth. The sinking of the land not only made the excellent harbor of New York, but also transformed what otherwise would have been a small, unnavigable stream into the broad Hudson estuary, up which boats may pass as far as Albany. West of this are the Great Lakes themselves--the result, in part at least, of glacial erosion and deposit.

The subsidence of the land and the glacier did not thoroly complete their work of connecting the sea at New York with the inland cities. There were gaps, like the rapids of Sault Ste. Marie and the Niagara cataract, to surround which, man's ingenuity needed to be called into play. There was also the strip of country between the lakes and the Hudson. The wise foresight of Governor Clinton and others in New York bridged the latter gap, the greatest of all, by building the Erie canal from Buffalo to the Hudson.

Physiographic features made the long Erie canal feasible. The region between Lake Erie and the Hudson consists essentially of four different kinds of country. First, near Buffalo, is a plain, easily traversed by a canal, but faced on the northward end by an escarpment, down which canal boats must pass by means of a complicated series of locks, determining the location of Lockport. Thence onward, from Lockport to Rome, is the third section, a broad plain leveled by glacial erosion and glacial deposit, and so veneered with glacial drift that canal excavation was easy. The fourth portion was down the Mohawk valley, for the most part a gentle slope, broken perceptibly in only one place, namely at Little Falls.

Had it not been for the glacial accident this latter section of the canal would have been much more difficult of construction, if, indeed, it had not been quite impossible. Before the glacier came, the present Mohawk valley was occupied by two streams, one, the shorter, flowing eastward, the other westward, with the divide between the two at Little Falls. The glacial deposits and the deposits formed in the bed of a lake that was dammed back while the ice occupied the St. Lawrence valley, so filled the westward stream valley, that, when the ice had entirely withdrawn so that the drainage of the present could establish itself, instead of the west-flowing stream there was a Mohawk, rising near Rome, flowing across the old divide at Little Falls, entering the short

preglacial Mohawk, and then joining the Hudson. These glacial deposits formed not only smooth beds for the canals, with a gentle slope toward the Hudson, but also soft material for excavation.

The building of the Erie canal located the city of Buffalo at the end of Lake Erie, where lake vessels from the west unload, and canal boats take up their burdens and carry them until the broad ocean itself furnishes the highway. The artificial plus the natural water-ways, have determined that to New York shall flow a large portion of the commerce of the great interior. It seems as if nature had intended that the site of New York should be the seat of the greatest city on the continent, tho, without man's aid in improving upon nature's water-ways, it would never have been brought about.

What might have been the case had the New World been developed after railways were fully established in the Old World, is difficult to predict. tho probably New York would have become of much less importance. However, once the water route was determined, the railway routes naturally followed.

The great fertile interior of the American continent is reached by two water routes—the St. Lawrence-Great Lake system, and the Mississippi. One might naturally expect the greatest cities to be located at the points where goods carried by water along one of these routes were transferred to ocean boats; and, in fact, we do find the large cities of New Orleans and Montreal at these points. But New York city has exceeded these two in growth for a variety of reasons. The other two cities are at the *natural* gateways to the interior. New York is at a gateway only partially opened by nature. Man completed the entrance by building the canals, and thus placed New York on a more equal footing with Montreal and New Orleans. With this partially artificial equality, by reason of other advantages, New York has been able to greatly outstrip the other two cities.

The disadvantage that Montreal has, comes partly from its more northern location, which determines that the river shall be frozen for many months during the winter season; but another important obstacle to the growth of Montreal is the fact that it is, thru political conditions, the outlet to only a small portion of the great interior. The fact that the boundary line of a foreign nation separates the fertile valley of the Mississippi and the

neighborhood of the southern shores of the Great Lakes, has prevented the utilization of the St. Lawrence outlet to the fullness that it would have been used under other political conditions. This is a greater disadvantage than it otherwise would be if, in central Canada, there were coal beds of as great richness as those on the United States side of the boundary line. Thus politically and physiographically, Montreal is less favorably situated than New York.

New Orleans has a number of physiographic disadvantages. These are partly climatic, for any city in a warm, southern climate is at a disadvantage compared with another in the cooler, temperate climate. A second important reason why New Orleans has not advanced as New York has, is the long distance of river navigation necessary to reach the abundant raw products of the upper Mississippi valley, and coupled with this, is the much greater distance from New Orleans to the European ports. Lack of coal and iron near at hand and absence of the abundant water-power which the glacier has so lavishly bestowed upon the northern states, have conspired to prevent the growth of industries, in the southern cities, which might have been tributary to the growth of New Orleans as those of the northern states have aided in the development of New York. Doubtless, too, the fact that the southern people have for so long a time contented themselves with the mere raising of raw products, and, as one result of this, the incubus of slavery, are causes of importance in the answer to the problem why New Orleans should have advanced so much less rapidly than New York.

Along the great water-route at the outlet of which New York is situated, are many cities located because of the facilities for transportation, and, in some cases, because of the added advantages of water-power due to glacial diversion of streams. Thus we have not only New York and Buffalo, but Albany, Syracuse and Rochester, besides a score of smaller cities.

The ease of communication furnished by the Great Lakes has had equally great influence upon the inland cities themselves, primarily because they open up what might otherwise be almost inaccessible raw materials, such as iron and lumber, and also furnish a means for the ready distribution of articles manufactured from them. Many details of physiographic causes for location of these cities might easily be brought forward, for each is

situated because of some favorable natural site. Chicago, for instance, is located upon a small harbor on Lake Michigan, not at its very end, but at the point where the lake waters flowed into the Illinois river when the northern end of Michigan was still filled with ice. It was seized upon as a natural site for a fort and village at a time when nothing further was needed in that part of the world. From this beginning, for many reasons, it grew far beyond the capacity of its tiny and very poor harbor. One of the most important reasons for the growth of the city after it once got a start, was, on the one hand, the neighborhood of the coal fields of the Central States, and, on the other, the accessibility to the sources of raw materials. A second reason for the development of Chicago was that, when railways commenced to be built, Chicago of necessity became a railway center, since those lines which were laid to northern Illinois, Iowa, Wisconsin, Minnesota, the Dakotas, and the more western states, in reaching around the southern end of Lake Michigan, naturally passed thru this place, previously located upon a small harbor formed by the wash of the ice-supplied water at the close of the glacial period. Without knowing this latter fact, one might well inquire why Chicago is not located at the very end of Lake Michigan.

The influence of physiography upon the habits of men and their degree of civilization is always an interesting theme. Climate is by far the most important of the several influences, and it is well illustrated by the differences between the peoples of the three zones. The inhabitants of the torrid zone have so much furnished them that there is little incentive to work. With the minimum of labor they obtain the necessities of life; and why should they develop the habit of work? Moreover, the climate is unfavorable to marked exertion; and people of energy who transfer their homes to torrid climates, are in danger of losing their ability to work hard.

The Arctic illustrates the other extreme. There the struggle is so severe that little energy is left for improvement. In order to obtain the bare necessities the Eskimos have a constant struggle, with no respite even during the winter season. There is almost as little chance for the development of civilization amidst these surroundings as in the torrid zone. Nevertheless, in order even to barely live, so much exercise of the intelligence is called for that none but an inventive race could survive the rigors of the climate

and the sparseness of the food. One who has given attention to the Eskimo habits and implements cannot but be impressed by the evidence of ingenuity that they show; and had they not shown it, they could not have lived where they do.

It is, of course, in the temperate belt that development of civilization is most easy, and, therefore, has naturally taken place. The struggle for existence is not very severe during the summer season, but provision must be made for the winter; and, having made such provision, there is thru that part of the year, leisure for self-improvement.

It would require a long and much more critical study than this to follow the development of civilization; but a few points connected with it, as illustrated in North America, may be touched upon. When Columbus reached the shores of America, there were living here, besides the Eskimos, a considerable variety of Indians, who may be grouped into three classes: the savages, the barbarous tribes, and the semi-civilized. The barbarous tribes practiced some of the arts of civilization, and for a part of the year had definite homes; but the savages roamed about almost at will, while the semi-civilized Aztecs had fixed homes and practiced many arts of civilization. The Aztecs and barbarous tribes were constantly menaced by their more savage neighbors, and. therefore, a high degree of civilization was prohibited, because, as soon as advancement and accumulation of property was carried very far, it served as an invitation of attack to the neighboring tribes. It was, therefore, in the least accessible portions that the highest degree of civilization was reached. The mountain and desert barriers of the southwest are doubtless responsible, in large measure, for the grade of civilization obtained by the Aztecs; and, if the development of civilization in the world were carefully looked into, it would be found that those nations which did advance, were permitted to do so by reason of natural obstacles to the encroachment of more savage hordes.

As a result of a variety of circumstances, there came, after a while, to be three European claimants to the major part of the American continent; namely, Spain, France, and England. An exhaustive study for the reasons of the subsequent events is, of course, impossible here. but there are one or two points of prime importance which may be briefly stated. Leaving the Spaniards out of the question, and considering only the relation of the

French and English, one point that strikes a student of the subject at once, is that, while the French had ready access to the interior of the continent, the English in the early days, were practically prohibited from reaching that interior. The barrier of Spanish occupation on the south, and of French on the north, was, of course, an effectual check to advancement in those directions; and the Indian, mountain, and forest barrier checked westward movement. The English population, therefore, became concentrated, while the French were scattered; and when the final struggle came, the attempt of the few to hold the large area claimed by France was, of course, futile. Thus, in large measure as the result of the influence of physiographic conditions, the French were driven from Canada. This concentration of the English population was an effectual aid in the revolutionary war, and may be counted upon as one of the prime reasons for the success of that fight for liberty.

A large number of detailed instances, as well as general illustrations, could be added to these without going beyond the limits of the United States. But the instances already given, mainly selected from very near at hand, and more or less at random, serve to illustrate the view which I hold concerning the proper application of physiography to geography. Similar illustrations abound, not only in America, but all over the world. Climate, topography, and other physiographic features determine where mining shall be carried on, what sections shall be used for ranching, where farming shall be practiced and what its nature shall be, and where our large cities must be founded. Knowing intimately the climate, topography, and mineral products of a section of country like that of the United States, one could predict with a considerable degree of certainty what occupations should be carried on in various sections, and that there should be large cities at the sites of Boston, New York, Philadelphia, New Orleans, Duluth, Toledo, San Francisco, and scores of other places. This being the case, the subject should be taught in such a way as to bring out this relationship. The only objections to it that I have ever heard urged are the difficulties of the subject, and the fear that the principles cannot be appreciated by the children; but in each case these objections have been grounded in lack of knowledge on the part of the teacher. There are no such difficulties unless one endeavors to go too far. When geography is taught in

a manner similar to that indicated, making use of causes to explain effects of a geographic nature, there will be less complaint that geography is uninteresting, and fewer remarks, such as one so commonly hears, that the geography he has learned has mainly come to him since he got thru studying it in school. It is, perhaps, unnecessary to add in closing that this is written with the full knowledge that just this kind of rational geography is now being taught in large numbers of the more progressive schools. The need is that more shall teach it.

LABORATORY WORK IN PHYSIOGRAPHY

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The day has passed, when in any well equipped high school or academy, the attempt is made to teach physics, chemistry, or any of the biological studies without laboratories, and a program which recognizes the needs and demands of these branches for the requisite time for laboratory work. Indeed, no school which did not provide such laboratories, would for a minute be considered well equipped for work in science. Altho this demand for the proper teaching of physics and chemistry has been recognized and pretty generally met, the claims of physiography are too often ignored, both by teachers, program-makers, and school boards. But it is not the purpose of this article to argue for laboratory work in this science. It is assumed that laboratory work has an important and necessary place in the teaching of physiography, and in this connection it should be understood that field excursions are to be considered as a part of the laboratory work. Granted, then, that in every well organized course in physiography a part of the time will be given to laboratory work, the questions to be considered briefly are, first, the laboratory and its equipment, and second, the nature of the work.

THE LABORATORY AND ITS EQUIPMENT

The expense of furnishing a geographical laboratory is small, as compared to the cost of the necessary apparatus for physics, and the expense of maintenance is far less than that required for chemistry. But even if the expense were equal or greater than for those sciences, it would be no valid excuse for not providing

the proper equipment: but the fact that the cost is small, ought to render it easier to start this work.

Prof. W. M. Davis has recently published[1] a brief description of a model geographical laboratory and its equipment, designed to accommodate about forty pupils during lectures or recitations, and eighteen at tables for laboratory work. All teachers who are planning the equipment of a physiography laboratory will find this paper very helpful. Tables are preferable to desks, since the latter are too small for the maps, etc., with which the pupils will often work. They should be of the proper height for the pupils to sit at their work, and sufficient elbow-room should be allowed. Eighteen is a good number to have in one section, and the difficulties in the way of successful work increase rapidly with every additional one over twenty.

The windows should be provided with opaque shades for darkening the room when the lantern is to be used, and a suitable screen on a spring roller, or a blank, white wall is necessary to receive the pictures. Cases with shallow drawers, or shelves, are needed to keep small models, maps, and specimens. Spring rollers arranged in a case, which is fastened to the wall, and is open at the bottom, afford the most convenient method of keeping wall maps which are frequently used. Others should be rolled up, marked with the name on the back, and placed on a rack where they are readily found when needed. Light, open frames eight or ten feet long, covered with coarse-meshed wire netting and fitted with weighted pulleys, after the manner of a window frame, so as to slide up and down, furnish a very convenient place for displaying small and unmounted maps, photographs, etc. S-hooks of copper wire or clothespins may be used to attach the maps to the wire netting. A wire strung tightly along the wall at the proper height is a simpler and cheaper means of hanging maps, but is not so convenient as the sliding frame.

A well equipped laboratory should have a small working library for reference. A list of fifty "best books" in geography was published in the *Journal of School Geography*, Vol. 2, p. 181 et seq. But I presume that comparatively few teachers of physiography can have a library of even this modest size. As a beginning of a working library, I should recommend duplicate copies

[1] Journal of School Geography, Lancaster, Pa., Vol. 2, p. 170 et seq., $1.00 per annum.

of the various text-books, *Davis's Physical Geography, Tarr's Elementary Physical Geography,* and his *First Book in Physical Geography, Geikie's Elementary Lessons in Physical Geography, Mill's Realm of Nature,* and *Davis's Elementary Meteorology.* With these books available, the pupils can do much better work than if confined to a single book.

Maps are simply indispensable in teaching physiography, whether to first or fourth year pupils, and every laboratory should be abundantly supplied. This can be the more readily done, since many of the most helpful maps can be obtained from the various United States government bureaus at prices which are only nominal. A small pamphlet entitled, "*The Use of Governmental Maps in Schools,*" by Davis, King and Collie, and published by Holt & Co., gives valuable information regarding the various maps—how to obtain them, and what ones to order. A helpful list will also be found in Appendix M of Davis's Physical Geography, and also in the *Journal of School Geography,* Vol. I, page 200 and Vol. II, page 170, et seq. In addition to a good set of wall maps of the continents in relief, such as are issued by various map publishers, and a globe, every laboratory should have a supply of the daily weather maps, selected sheets of the United States topographical atlas, selected charts of the United States Coast and Geodetic Survey, and of the Mississippi River Commission, and pilot charts of the Atlantic and Pacific oceans. Geographic relief models, either of actual or ideal regions, are of great value in laboratory work. Unfortunately the cost of these is so considerable, that it will probably be some time before we can hope to see them in general use in all schools where physiography is taught. The Harvard Models, designed by Prof. Davis and Mr. Curtis, and for sale by Ginn & Co., are by far the best for schoolroom work and are comparatively low in price. Mr. E. A. Howell of Washington has a large assortment of larger and more expensive casts.

A small collection of common rocks, and of the principal rock making minerals, is of great value in teaching so much of this phase of geology as is necessary to a recognition of the most common rocks, and the conditions of their origin. In many schools a collection suitable for such purposes can be made by the pupils themselves. Small collections of fifty specimens each, of common rocks and minerals can also be obtained from E. A. Howell, Washington D. C., at prices something less than $3.00.

Perhaps the most expensive part of the equipment, and certainly one of the most essential, is a lantern and a supply of slides. The importance of these aids to the teaching of physiography and the proper understanding of land forms can hardly be overestimated. There are various styles of lanterns now on the market at prices ranging from $50.00 to $100.00 or more. Lantern slides cost from forty to fifty cents[1] apiece or $30.00 to $40.00 per hundred. A small set for elementary physiography, arranged by Prof. W. M. Davis, can be obtained of E. A. Howell, Washington, D. C. A very important way in which the American Bureau of Geography may assist its members will be in the exchange of good lantern slides for geographic teaching. Where a lantern and slides are impossible of attainment, their place may be partly filled by geographic photographs, half-tones, etc. Pictures from illustrated papers and magazines, pasted on large pieces of cardboard or stiff brown paper, and carefully labeled are often helpful, when properly exposed for study.

For laboratory work in connection with the atmosphere, wet and dry bulb thermometers and a barometer are needed. A wind-vane is usually visible on some neighboring steeple.

It is not necessary that all the equipment here suggested, and described at greater length in the various articles referred to, be purchased at once. Nor ought any teacher to postpone laboratory work until an expensive and complete equipment is at hand. A small sum of money invested judiciously each year will in a few years provide a fair equipment, and in the meantime the teacher will doubtless learn how better to use what is at hand, and will make fewer mistakes in ordering materials than if a large sum were to be spent at once. Failure may result from an embarrassment of riches, as well as from poverty. And it must not be forgotten that after all the *field* is the best laboratory for geography, and that it is one in which as much of the work as possible should be done.

LABORATORY EXERCISES

The amount and nature of the laboratory work to be undertaken depends upon a number of factors. The age of the pupils, the size of classes, and the length of time available, both for the whole course and also for each day's work, are the most important

[1] Slides are made to order by the American Bureau of Geography for twenty-five cents each—best material and workmanship. See report of Official Photographer in this issue.—EDITOR.

of these. Other things being equal, a longer time will be necessary for first year high school pupils than for fourth year pupils to accomplish the same work. So far as my own experience goes, the quality of the work does not differ markedly; but the time necessary, and the explanation and detailed direction required, is much greater for the younger pupils.

The most satisfactory work can be accomplished with sections not exceeding twenty. Some laboratory exercises cannot be taken up with larger numbers, and for many even a smaller class is better. Where a teacher is required to handle classes of forty and fifty, as is sometimes the case, laboratory work in physiography is as well nigh impossible as laboratory work in chemistry or physics would be under similar conditions.

The ordinary recitation period of forty or forty-five minutes is too short for laboratory work in any subject. In other sciences the school program is almost always arranged so that the laboratory period shall be a double period, and the same right should be accorded physiography. It need not come every day, indeed, it is far better that it should not come every day unless on more than half the days a part of the time be spent in text-book study and a part in recitation. The ideal arrangement is one which gives a double period to each section on every day in which the subject is taken up. The laboratory work can then fit into its proper place with the study and recitation work without any trouble, and the teacher is perfectly free to take up any phase of the work on any day as he sees fit. If to this, there can be added a period to be used occasionally, when all the sections can meet together for an informal lecture or an exhibit of lantern views, the perplexing question of hours and periods is adjusted beyond all criticism—from the physiographer's point of view, whatever may be the jealous opinions of other less favored branches. But I am afraid that the schools in which this ideal condition prevails are exceedingly few, and we must adapt our plans to less favorable conditions and arrange our exercises as best we may to fit the exactions of the schedule maker. Doubtless opinions differ as to the proportion of the whole time to be allotted to laboratory work. My own opinion is that from one-fourth to one-third of the total time available should be given to this.

The actual laboratory exercises undertaken, their number and the time given to them, must in the nature of the case, be variable

for each school. A number of outlines have been published, and I shall not do more here than to refer to them. In the *Journal of School Geography*, Vol. I, p. 172 et seq., and 204 et seq., the laboratory work at Morgan Park Academy is described by R. H. Cornish. The committee on physical geography to the Natural Science Department of the National Educational Association, has outlined another set of exercises (*Journal of School Geography*, Vol. II, pp. 257-258). For hints on laboratory work in connection with the study of the atmosphere, see a series of papers by J. M. Jameson, in the same magazine, Vol. II, pp. 5, 56, 96 and 139. The equipment of a meteorological laboratory is described in the same journal in Vol. III, p. 241, and Ginn & Co. have published a little book on *Practical Exercises in Elementary Meteorology*, by the same author, R. DeC. Ward. Still another set of exercises covering the whole subject, but emphasizing the study of maps, is given by W. H. Snyder, in the *Journal of School Geography*, Vol. III, p. 368. The appendix to *Tarr's Elementary Physical Geography* also contains many good suggestions for laboratory work. Any teacher who will consult these papers will find an abundance of material for a course. The difficulty may be more in the wealth of material offered than in the lack of suggestions.

The nature of the field-work, too, must vary greatly, according to the locality of the school. Some regions present a much greater diversity of geographical facts than others. But there can hardly be a region where some phases of weathering and river-work cannot be illustrated out of doors. There is no region in the northern part of our country where a considerable variety of stones may not be found, and over most of this area abundant traces of glacial action are visible. Often a small pond, or even a pool will illustrate many of the phenomena of lake and ocean shores. The wide-awake, observant teacher will not fail to find numerous illustrations of geographical processes and the resulting land-forms, no matter what her environment.

Notes should be kept of all laboratory and field work, and the results of the pupils' observations written up in a substantial note-book. If the work is worth doing at all, it is worth doing well, and cheap, flimsy notebooks with poor paper, should be debarred. These should be examined by the teacher from time to time and corrected, more or less in detail, as seems to be demanded. Laboratory directions should be clear in statement, and so complete as

not to permit the possibility of error. They may be written on the blackboard, or better still, mimeographed copies may be given each pupil. At first the pupils will need constant supervision and assistance, and the laboratory hour will not be a time of rest for the teacher. But the results in renewed interest and added acquisition on the part of the pupils will repay the extra labor, and will incite the enthusiastic teacher to further efforts.

INTRODUCTION TO PHYSIOGRAPHY OF LAND FORMS

BY WILLIAM C. MOORE, STATE NORMAL SCHOOL, SALEM, MASS.

"The ruins of the old land furnish the materials of the new." So spoke James Hutton years before the popular mind was ready to accept the notion that all this habitable earth, with its rock-built mountains and flowery plains, is forever growing and perishing in eternal birth and death. The conception of a world formed just as it exists today, and undergoing no change, is against all laws of nature. We learn from a study of the wet-weather streams, brooks, and rivers, from the work of the waves along the shore, from the decay and crumbling of the rocks to form soil, that all the land forms are slowly wasting away under the destructive attack of the weather.

To appreciate and understand the consequences of this, we must study that wonderful, altho commonplace, reaction of the rain, frost, ice, and changes of temperature, upon the rocks—in brief, the process of weathering. The bleaching of the feldspars, the rusting of the ferruginous rocks, the removal of solluble minerals making porous or honey-combed fragments, the concentric weathering of the granite and diabase, and the complete disintegration of the softer rocks are among the wonders of nature. This decay of the smaller fragments of the rocky hills tells us in a way which our finite experience can easily understand, the fate of those grander piles of stone whose very vastness prevents us from detecting the changes which, in terms of our human estimate of time, go on so slowly. The passage of time required to bring about changes in the forms of the land, makes us feel that a thousand years are but as yesterday.

A study of some excavation in which the soil is seen in its

relation to the bed rock from which it has been derived, will show the accumulated consequences of this process of weathering. A granite quarry which I have in mind, and which has for some time been exposed to the action of the weather, contains large masses of rock, showing beautifully the concentric weathering. Smaller angular fragments have been broken off near by. Many of these have already disintegrated, and form the finer material which rests upon the bed rock and fills up the cavities and crevices. This finer material is already fertile enough to support an abundant vegetation. A less resistant rock, like some sandstones and slates, would show an almost imperceptible gradation from the clear, solid rock to the dark, loamy soil. Sometimes the bed rock is saved from this decay by the protective covering of material left by the glacier. But the boulders and fragments forming this covering undergo no less a change. In fact, excellent examples of decaying rocks of various compositions and textures, can be found side by side, and afford a striking illustration of the fate that awaits all things temporal.

What seems absurdly monotonous to the uninitiated, is to the enquiring observer a marvel of truth. A trained mind will see enough for a month's study in a single plant, or find quarries of truth in a gray, weather-beaten ledge or tell from a pebble what happened a hundred thousand years ago. Many are willing to accept in a passive sort of way the fact that changes are everywhere in progress, but the student who works that fact out for himself by a study and comparison of different localities will appreciate the beauty and the impressive truth of the lines:

> "The hills are shadows, and they flow
> From form to form, and nothing stands."

The accumulation of soil, whether it be the legacy of the glacier or the result of weathering, when it reaches a certain depth will prevent further changes in the bed rock. Weathering unaided by other forces, then, would soon bring about not change, but permanence. But the subaerial forces have strong allies to aid them in their work of destruction. A landslide lays bare a rocky gash in the mountain side, and tons of soil are hurled down into the valleys. The mountain torrent carries fragments, large and small, and the meandering stream in the broad and level plain labors slowly along with its share of material. The wet-weather stream—a type of the mountain torrent—makes deep gullies in

the hillsides. The heavy rains loosen and wash to lower levels, the fragments of soil. The winds blow the dust and sand about, and in arid regions, unprotected by a cover of vegetation, are a powerful agent of denudation and transportation. But the most subtle work--comparable to the weathering of the rocky surfaces in its deliberateness—is the creeping or moving of the soil down the gentle slopes. The rushing of the avalanche down the steep mountain side is sudden and spectacular; the movement of the soil on the fainter grades,

"Noiseless creeping, while we're sleeping,"

is unseen, unfelt, perpetual.

The most important agent in the removal of products of weathering is the river. The process by which the soil is borne along in its journey to the sea is called *transportation*. A certain amount of the surface of the land is washed into the main stream and its numerous branches by each rain storm, as the color of the water of even the largest rivers after a heavy rainfall will testify. Evidence that the river in the course of time transports a large amount of material is seen in an accumulated form where the stream enters a larger body of water, whether it be a lake or an arm of the sea. The Rhone, turbid with suspended waste, enters the eastern end of Lake Geneva thru a delta twenty miles long. This delta is a result of deposition, and has grown since Roman times more than a mile forward. Eventually the beautiful lake will be changed to a broad, level plain. Adria, a town twenty miles from the coast of the Adriatic sea, was a seaport when its name was given to that body of water; but the sediment brought down by the Po, and deposited at its mouth, has made Adria an inland town. Sometimes the main river is unable to carry all the waste brought down by its tributaries, for the greater the number of side streams the more quickly will the surface of the land be washed into the rivers, and the greater the work which the main stream will have to perform in carrying the waste to its ultimate resting-place, the ocean-bottom. This is the case with the Mississippi river, which in addition to building forward an enormous delta at its mouth, is also raising its own bed by depositing sediments to such an extent that the river is actually flowing on a ridge above the general level of the surrounding plain. The river Po also shows in a marked degree this startling relation of water

level to the adjacent plains. Recent investigations have shown that in the normal condition of the river, the surface of the water in the neighborhood of Ferrara is somewhat over eight feet above the surrounding plains, while in flood time the water in some places rises from sixteen to twenty feet above the plain. No matter how much waste is furnished the river for transportation, it never overloads itself. It can carry just so much, according to its volume and rate of flow. Anything in excess is left until a future time, when perhaps the amount of waste brought down from the higher lands in which the tributaries have their sources is lessened. Then the river begins to carry what was left behind in busier times, and sooner or later all the soil is on its journey to the sea.

The sea, resenting this encroachment upon its domain, in turn, attacks the land. Armed with pebbles, the angry breakers fling themselves against the rude and sturdy coast (Fig. 1). Incessant is the warfare, and in time the ocean must prevail. The shores, worn out, their substance consumed in the futile defense, retreat to new positions; the seas advance, and where

"Armed with pebbles, the angry breakers fling themselves against the sturdy coast."

once the dry land stood, deep water now is found. The best opportunity for a study of the action of the waves is found upon that part of the shore made up of rocky headlands, with smooth beaches between. Here it will be seen that the rocky cliffs show more destruction than the loose material making up the sand and gravel beaches. In fact the waste from the cliffs is used by the beach as a protective covering against the assault of the waves. On examination, the rocky cliffs (Fig. 2) will show many lines

"Steadily backward the ocean forces the rocky shore."
CLIFFS AT GRAND MANAN, NEW BRUNSWICK.

of weakness existing as cracks, or joint planes. These planes run in three directions approximately at right angles to each other, breaking up the cliff into cubical blocks. The assault of the surges upon this weakened structure soon loosens and removes these fragments, which serve the ocean as projectiles for future use in its battery of waves. Sometimes the weathering of a softer vein in the rock presents a re-entrant angle, a breach wherein the ocean concentrates the force of its attack. Or perhaps a line of

harder rocks throws itself defiantly forward and provokes the assault of the waves. Steadily backward the ocean forces the rocky shore, reducing its irregularities to a smooth and even outline by consuming the headlands and filling up the bays. The sand and gravel composing these even shore lines are ground into finer and finer particles as the waves roll them up and down the beach, until they are caught by some off-shore or along-shore current and carried beyond the reach of their enemy, the waves, to find a resting place fathoms deep beneath the ocean.

The inevitable consequences of this destructive attack of the weather and waves, must, unless some interruption occurs, finally bring the surface of the land beneath the level of the ocean. The difficulties in the way of our grasping this proposition are mainly due to our inability to conceive time as the earth measures it, and to the apparent slowness of geographical changes. When we reckon our own lifetime in terms of geological or geographical development, we begin to realize, perhaps unpleasantly at first, what an insignificant portion of the world's existence is allotted to our human experience. We last but a second in time, and we occupy but a point in space. We are simply an ephemeral bridge across which the generations march in their onward progress.

Altho ample time has already elapsed since the present continents were raised above the ocean to bring about their complete destruction, lands of considerable altitude still exist. We must look, then, for some factor which has counteracted the down-wearing and destruction, and we find it in the force which tends to raise the level of the land. As a result of the contraction of the earth's interior, the outer portion is drawn into a series of folds or wrinkles, causing, in some localities a downward, in others an upward movement. The continents have been formed by a broad uplift, in parts of which a local and more intense up-folding has formed the mountain ranges. Slight changes in level are nowhere better shown, or more easily recognized, than at the seashore. Observations show that during the last hundred years the coasts of Massachusetts and New Jersey have been sinking at the rate of a couple of feet in a century. The coast in the neighborhood of Salem, Massachusetts, where I am writing, shows well-marked evidences of subsidence. Buried peat swamps and trunks of trees, as well as an increase, by actual measurement, in the depth of water over ledges, leave no doubt of

this fact. The coast of Sweden is rising, while the Netherlands have sunk so low that it is necessary to dike the fields to keep the ocean from claiming them. Change of level is of importance in saving the land from destruction, only where it results in uplift. Subsidence acts in co-operation with weathering, to bring about a more rapid degradation of the forms of the land to the level of the ocean. Elevation, uplift, is the regenerating force which saves the land from this fate, and preserves to us the vigorous mountains and the fertile plains. Thus two sets of forces are at work modifying the face of nature—changes in level, and waste due to weathering. The weather, the waves, and the rivers, may be classed as destructional forces. The forces of uplift and renewal, on the other hand, may be called constructional forces.

The present altitude of the land, its relief, its scenery, is the net result of the interaction of these forces of waste and renewal. The very moment that new land is raised above the level of the sea, even before the work of uplift has ceased, the work of destruction begins. On the other hand, whenever the river, overloaded with sediment, deposits some of the material to form a flood plain or delta, it changes immediately to that extent from a destructional to a constructional agent. It is customary to distinguish the land forms as constructional or destructional forms according to the degree in which these forces are responsible for their present condition. Thus the continents and mountain ranges are, broadly speaking, constructional forms; the irregularities, the relief, the modifications in the scenery produced by the forces of waste, make them to that extent destructional forms. In place of the term *constructional* applied to a land form, *initial* is sometimes used as indicating more clearly its momentary existence, for a form loses its truly constructional phase the instant that weathering begins. Other illustrations of initial forms, altho resulting as a by-product of destructional processes, are the volcanoes, the glacial deposits, and the beaches, bars and sandy islands thrown up by the waves.

Two terms, *baselevel* and *cycle*, require some explanation here. The lowest plane down to which the land can ultimately be worn by the action of the weather and streams is the level of the sea. This is called the baselevel. The period required for the consummation of this result is called a geographical cycle. It cannot be reckoned in years or centuries, and its duration varies with the

resistance of the rocks and the strength of the destructive processes.

It is important to note that whatever initial form exists at the beginning of a geographical cycle, a certain general succession of topographic features must inevitably result from the action of the destructional forces. This sequence of form is so systematic that the particular part of the cycle in which any land mass belongs at the present time can be recognized. The development of coastal plains will illustrate this statement. The initial form presented to the attack of the weather would be a smooth, unbroken stretch of land sloping gradually from the old shore line towards the sea. On a small scale, we have a good illustration in the mud flats which are left bare by the fall of the tide. The rain falling upon the unbroken surface with no river valleys to direct its course, would accumulate in slight hollows and inequalities, much of it soaking in and evaporating, until some water accidentally discovers a path of escape to the sea. This would lead to a very simple kind of drainage, consisting of a few main streams, at first without branches. The main streams would soon deepen their beds in the soft material of the new land, making narrow trench-like valleys with broad, smooth plains between. These are the characteristics of *youth*. Excellent illustrations of land forms in the youthful stage of development and in the stages yet to be described will be found in the first folio of a Topographic Atlas of the United States.[1]

The stage of *maturity* in the life of the coastal plain is attained when the relief has reached its utmost development. This stage occurs when the flat, interstream surfaces of the youthful stage have been carved into valleys by the intricate system of tributary streams; when the divides separating adjacent water-sheds are no longer the flat, level reaches of land, but sharply defined ridges; when the next result of the action of the weather would be a lowering of the crest of the divides.

Following the stage of maturity comes the time of diminishing activities, when the relief begins to fade and the period of *old age* approaches. The main valleys have already become broad and level, with the rivers meandering freely in long, sweeping curves. The sharp lines of the divides among the tributary streams are

[1] Physiographic Types, U. S. Geol. Survey, Washington, D. C. Price 25c.

becoming smoothed and lowered; and the smaller rivers are shrinking at their sources because the gently rolling surface allows the water to stand and evaporate, and prevents quick delivery to the streams. Lower and lower sinks the altitude of the whole region, and, as baselevel is reached, the appearance of extreme old age resembles that of early childhood; and the cycle is completed.

In conclusion, let me impress that altho the passage of time is an important and necessary condition for the development of topographic form, yet the age of the land is not dependent upon that factor alone, but also upon the resistance of the rocks and the strength of the destructive processes. The intensity of relief is a key to the stage of development and determines the age of the topographic form. This requires an understanding of the present aspect of the land in its proper relation to the past and the future. In another way the age of the land form may be determined by comparing the amount of work already performed with the amount yet to be done in reducing it to baselevel.

PRELIMINARY REPORT OF THE COMMITTEE ON LANTERN SLIDES

BY E. R. SHEPARD, OFFICIAL PHOTOGRAPHER, MINNEAPOLIS, MINN.

The more consideration given the subject, the more the committee desires the help and advice of the members of the Bureau; and all are assured that any assistance or advice proffered will receive appreciative and careful consideration.

It seems desirable that the selection of subjects should be made with a view to meet the needs in both general geographical study and in special lines of investigation, and that, too, as nearly as possible in order of primary importance. The scenes submitted with this report have been chosen, not for their primary importance, but because of being material ready at hand, and serving to show the present idea of your committee as to what is a proper course for it to pursue in the selection and arrangement of material for the illustrative work of the Bureau. For example, in the subject of *Water Falls*, the purpose is to present views of some of the most noted falls in such manner as to exhibit their natural grandeur and beauty, as well as to show examples of those

harnessed for the service of man. The lakes afford an opportunity for views of our most interesting types in mountain and plain. The single harvesting scene submitted is one of a proposed series, illustrating the line of study properly called the "Production and Movement of Wheat," included in the broader topic of "Agricultural Products." Without further detailing the purpose of each scene submitted, and hoping they are distinctive enough in character to suggest the purpose for which they were selected, we desire to say that the lines of study commenced will be enlarged and completed in subsequent reports. Other subjects will also be added, as rapidly as is desirable, out of available material at hand, and from such photographs as members of the Bureau may forward us from parts of the country not accessible to your committee. In this report, but a small part of the available material has been submitted, as it has appeared best to publish with each report only a limited number of scenes, and thus make it possible for members to obtain, without much outlay at any one time, all the material as the same is ready for distribution.

The members of the Bureau may feel assured that the exceedingly low price of lantern slides does not mean that they will be of inferior quality, as no slides or other material will be sent out except it be of the finest quality. Slides will be made to order, either from material on hand or from negatives or photographs sent by members, for the uniform price of twenty-five cents per slide. Photographic prints, size 8″x10″, of all subjects submitted, can be had at fifty cents each, or $4.80 per dozen; and bromide enlargements from the original negatives may be had mounted and ready for framing at the following prices:

11″x14″	$1.25 each
14″x17″	1.50 "
16″x20″	1.75 "
18″x22″	2.10 "
20″x24″	2.40 "
30″x40″	5.00 "

To this must be added an additional twenty-five cents for boxing and forwarding. The exceedingly low price at which the material will be furnished the Bureau, does not permit the opening of accounts with members ordering slides or pictures. All orders accompanied with remittance to cover same will be promptly filled.

In case an order is for a greater amount than $5, and the purchaser desires the balance shipped by express C. O. D., it will be so forwarded provided at least $5 accompanies the order. Orders for less than $5 cannot be sent C. O. D. All goods will be carefully examined and securely packed. Any loss or breakage in transportation must be looked after by the purchaser, and he must see that the transportation company makes good such loss.

With each view submitted, will be given, as far as possible, a brief description of its location, and such other matter as is necessary to make it intelligible. With the help of the various committees on Geographic Literature, a very complete list of references on the subjects shown is being prepared. Members who know of helpful articles in books and magazines can aid the work by communicating with the Director of the Bureau. A list of references will be published as soon as a set of illustrations on any one geographic subject has been made reasonably complete. It is desirable that the descriptive matter be retained by members of the Bureau, as lantern slides and photographs will be marked only by name and number.

No. 1. "A General View of Niagara Falls from Suspension Bridge"—Showing Prospect park, American Falls, Goat Island, and the Horse-Shoe or Canadian Falls. (Note—Slides can be furnished of the different falls in detail, and of the gorge and rapids below the falls.)

No. 2. "Minnehaha Falls."—This water fall, made famous by Longfellow, is now a part of the extensive park system of the city of Minneapolis, and is visible from the car windows of the C., M. & St. P. Ry. Height of the falls, sixty feet.

No. 3. "The Great Falls of the Missouri River"—Situated twelve miles below the city of Great Falls, Mont. The height is ninety feet, with a width of 1,800 feet. The series of falls and cascades in the river reaches a total fall of 520 feet.

No. 4. "Black Eagle Falls and Dam"—Situated within the limits of the city of Great Falls, is the upper one in the series of cataracts. In the view is shown the dam and falls, which constitutes the water power used by the smelters of the Boston and Montana Mining and Smelting Co. These copper smelters occupy the left bank of the river. Over the falls are seen the suspension bridge, and the cable which transmits power for the electric lights and

street railways of the city. The width of the falls and dam is about one thousand feet, with a head of twenty-one feet.

No. 5. "The Falls of the Spokane."—This scene is a partial view of the upper falls, which has a height of sixty feet, and is situated in the heart of the business portion of the city of Spokane.

No. 6. "Lower Falls of the Spokane"—Near the street railway bridge. On the right is shown the electric light and power house, which is utilizing but a small part of this tremendous water power. The height of the lower fall is seventy feet.

No. 7. "Snoqualmie Falls, Washington"--Is situated about forty-five miles northeast of Seattle. It is one of the most beautiful falls on the American continent. The entire volume of the Snoqualmie river is narrowed just above the brink of the falls to about eighty feet in width, and is madly forced around the projecting rock in the center of this channel and plunged over a precipice 268 feet high. Since this photograph was made this bit of nature's sublimest beauty is being transformed into a mighty water power.

No. 8. "Mineral Hill. Butte, Mont."--As seen from the principal hotel in the city. The view shows the shafts of but a few of the many silver and copper mines which literally honey-comb the ground upon which this world's greatest mining camp in situated. (Note--It is the purpose to submit a complete set illustrative of this branch of industry.)

No. 9. "Harvesting Scene, Blanchard, N. Dak."--The view shows eight of the fifteen binders, which is a part of the equipment of this 10,000-acre farm. The practice once followed on these bonanza farms—and which still exists in the minds of those unacquainted--of massing together a large number of machines under the direction and supervision of a foreman, is now abandoned so far as is possible. More work, it is found, may be accomplished by each machine working independently of others.

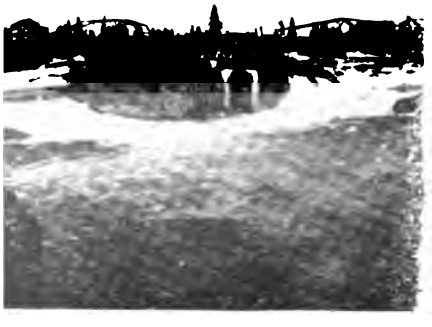
No. 10. "General View of the Sault Ste. Marie Locks."—The scene is taken from the tower of the power house, and shows the old lock on the left, in which is the steamship Northwest of the the Northern Steamship Co. On the right is the new lock, with boats passing to Lake Superior. The former is 800 feet long between gates, and the latter 1,000 feet. This double lock is situated on the west bank of the St. Mary's river, while the new

o. 1. **NIAGARA FALLS.**
From Suspension Bridge.

No. 2. **MINNEHAHA FALLS.** Minnesota.

o. 3. **Great Falls of the Missouri.**

No. 4. **Black Eagle Falls and Dam.**



o. 5. **Upper Falls of the Spokane.**

No. 6. **Lower Falls of the Spokane.**

No. 7. Snoqualmie Falls, Wash.

No. 8. Mineral Hill, Butte, Mont.

No. 9. Harvesting Scene, N. Dakota.

No. 10. General View, Sault Ste. Marie Locks.

No. 11. S. S. "Northwest," St. Mary's River.

No. 12. Fusilade Mountain, Northwestern Mont.

No. 13. **Lake McDonald, Montana.**

No. 14. **Upper End of Lake McDonald.**

No. 15. **Avalanche Basin, Montana.**

No. 16 **Moraine and Front of Sperry Glacier.**

No. 17. **Crevasse in Sperry Glacier.**

No. 18. **Grinnell Glacier Near Lake McDonald.**

Canadian lock is on the east bank. Above the locks and crossing the river, may be seen the Canadian Pacific railway bridge. Your committee has on hand a very complete set of negatives of the American locks, showing in detail their construction and working.

No. 11. "The Steamship Northwest in St. Mary's River." – (Note—This is one of a proposed series on the commerce of the Great Lakes.)

No. 12. "Fusilade Mountain."—The following views have been selected from the main range of the Rocky Mountains, in northern Montana, just south of the international boundary line, in what is known as the Crown of the Continent. They illustrate a part of that very interesting country reached by the Great Northern railway, and carefully described and illustrated in a 200 page brochure entitled, *Across America.* Copies of this pamphlet may be obtained by members of the Bureau by addressing F. J. Whitney, Gen. P. & T. A., St. Paul, Minn. This scene shows the mountains enclosing the upper part of the upper of the two St. Mary's lakes. The lake is about sixteen miles in length, and varies in width from two miles to as many rods, where it is narrowed down by the mountains which rise on either side. The lake lies on the east side of the main divide, and its waters flow northward into Hudson bay.

No. 13. "Lake McDonald, Montana"—West of the main range of the Rocky Mountains, thirty miles from the St. Mary's lakes, is one of the most beautiful mountain lakes to be found in our country. The scene is taken from a mountain side about two miles below the outlet, and shows the lake shut in by densely wooded and almost parallel mountain spurs, 2,500 feet high. Its width is about six miles, and length sixteen miles. It fills the bed of an extinct glacier, the terminal moraine of which, now densely covered with cedar forests, lies like a dam across the valley and forms the lower shore of the lake.

No. 14. "Upper End of Lake McDonald" - Shows about three miles of the upper portion of the lake from the hotel grounds. In the distance is shown a bit of the mountain divide of the Rocky mountains, twenty-five miles distant; just beyond lies a beautiful glacier named Grinnell glacier. On the right may be seen Goat mountain, at the foot of which lies Avalanche basin.

No. 15. "Avalanche Basin."—This beautiful basin is enclosed by the main wall of the Rocky Mountains. It is about three

No. 19. Chaney Glacier, Montana.

No. 20 Artist's Point and Emerald Lake

No. 21. Summit Lake and Pyramid Valley.

No. 22. Pyramid Peak, Montana.

No. 23. General View of Basaltic Formation, Columbia River.

No. 24. Basaltic Formation of the Columbia.

miles long by a mile in width, and lies directly below the Sperry glacier, the upper part of which may be seen in the picture. The lowest part of the wall surrounding this basin is at the falls on the left, and is 2,300 feet above the level of the lake below. The mountains constituting its southern and northern walls rise from 5,000 to 7,000 feet above the lake level. The basin is readily accessible to tourists, and forms an ideal excluded camping ground. Its charm and beauty is beyond description.

No. 16. "The Front of Sperry Glacier"—The drainage from this glacier flows into Avalanche basin. Its front is one and one-fourth miles in length. On the left is shown moraine material reaching a height of fifty feet. The rapid receding of this glacier from this accumulation of moraine, and the formation of the new moraine, as shown in the picture, presents an interesting geological problem.

No. 17. "A Crevasse in the Sperry Glacier"—Formed by the movement of the ice mass.

No. 18. "Grinnell Glacier"—Is situated on the east side of the main divide, and is one of the most interesting scenes in this part of the Rocky Mountains Its back wall is visible from Lake McDonald, and is easily accessible from the west side by a climb of about eight thousand feet.

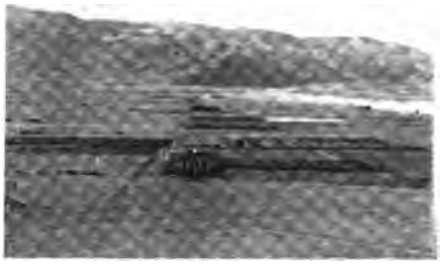
No. 19. "Chaney Glacier"—The view shows a part of the surface of this interesting glacier lying on the east side of the main range, and about six miles north of Grinnell glacier. In the foreground is a quantity of moraine material, deposited on the upper surface of the body of ice.

No. 20. "Artist's Point and Emerald Lake."—On the right is a glimpse of the lower neck of Chaney Glacier. In the center stands Artist's Point, about six thousand feet above the lake at the left, which lies two miles from the point of view.

No. 21. "Summit Lake and Pyramid Valley" As seen looking north from the north rim of Chaney glacier. The lake with an altitude of about eight thousand feet, is at no time of the year free from ice. Beyond it may be seen a typical mountain view.

No. 22. "Pyramid Peak"—A nearer view of the mountain seen in the preceding view, has an elevation of about five thousand feet, and is one of the peaks in the main divide just south of the boundary line. The distance from camera to mountain is seven miles, while the distance to the farther peak is about seventy miles.

No. 25. **Basaltic Formation of the Columbia.**



No. 26. **Wenatchee Valley.**

No. 27. **Approach to the Rocky Mountains.**

No. 28. **Bad Lands of the Missouri.**

No. 29. **Docks and City of Seattle.**

No. 30. **Mount Rainier from Seattle.**

No. 23. "A General View of the Basaltic Formation on the North Bank of the Columbia River"—From the Great Northern railway tracks. The height of these basaltic bluffs is about 2,500 feet above the surface of the Columbia river. They form a part of the southern boundary of what is called the Big Bend country. This volcanic formation extends eastward to the eastern boundary of the state of Washington.

Nos. 24 and 25. "Detail Structure of the Palisades of the Columbia."

No. 26. "Wenatchee Valley."—The scene is a general view of this interesting valley, which lies south of the Columbia river, seen at the right. In the distance, fifteen miles away, are shown the beautiful bluffs which form the edge of its basin, stretching away to the north. The valley consists of a level stretch of sand profusely covered with sage brush, in the midst of which, by means of irrigation, stand some of the most beautiful and valuable fruit ranches to be found in the Cascade region. This valley is destined to become one of the most noted in the state of Washington.

No. 27. "Approach to the Rocky Mountains."—The scene is a glimpse of the east side of the Rocky Mountain ranges, as seen from the plains stretching eastward from their base.

No. 28. "Bad Lands of the Missouri Valley."—Along the slopes of the basin of the Missouri river, at various points in Montana and Dakota, are found peculiar scenes of erosion by wind and water, called Bad Lands. This particular scene is in the western part of North Dakota.

No. 29. "Docks and City of Seattle, Wash."—From the growing importance of Puget Sound and its various ports in the opening up of trade with the Orient, it seems important to present this view as one of a proposed series on "Ocean Commerce."

No. 30. "Mt. Rainier from Seattle." This scene is a telescopic photograph of Rainier, seventy-five miles distant, taken at Seattle, July 3d, 1899. The elevation is 14,444 feet above sea level; and as its base is on a level with the sea it presents one of the loftiest and grandest examples of a single mountain found on the globe. Above the main range of the Cascades, which constitutes its densely wooded foothills, is this immense snow and ice crowned dome, at one time a living, active volcano.

SUGGESTIONS AS TO THE EXCHANGE OF GEOGRAPHICAL MATERIAL

BY PHILIP EMERSON, CHAIRMAN OF COMMITTEE ON EXCHANGE OF PRODUCTS

It will be well at the start to recognize the limitations and difficulties incident to the collection and effective use in teaching of material illustrative of geographical topics. To obtain material is really easier than to fully understand it, and often less expensive than to properly prepare it for ready use by pupils. What a teacher secures herself from field and factory will be of most value in her work. Notwithstanding, a systematic plan of exchange will doubtless be of aid, and especially so to those who have done the most without such aid.

To make material offered in exchange of prime value, it must be carefully selected, well packed for shipment, and a full written account prepared to accompany it. Since many will be ready to pay for illustrative material who feel unable to prepare any to offer in exchange, it will be desirable for this purpose, and also to make it easier to arrange fair exchanges, that a valuation representing the cost of preparation be placed on each exchange offered.

The range of material offered may include the raw materials of commerce, mineral, plant, and animal, and specimens showing the changes incident to their conversion into finished products, such as metals, foods, textiles, woods, etc. Specimens illustrative of human life are most desirable as well, and here the Bureau should prove of peculiar value to us all. Such material may include utensils, articles of clothing, toys, and whatever would make clear peculiar ways of peoples.

In order to ensure uniformity and satisfaction in exchanges, it will be necessary for all desiring and offering exchanges to first

correspond with the head of the exchange department, sending to him a sample of the material offered in exchange, accompanied with a description, and naming cost valuation placed upon it. Upon its approval it may then be listed in the next issue of the Bulletin, and thereafter exchanges may be arranged direct between members on the basis of offers approved and announced. An illustration of such an announcement is given below:

FLAX.—Scutched flax (Russian, Dutch, Flemish, American), and dressed flax; and specimens showing changes from flax to linen thread and yarn. Thousand-word type-written description of process of manufacture, and bibliography of publications on flax and linen. $1.00.

PHILIP EMERSON,
Principal of Cobbet School, Lynn, Mass.

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ENROLLED DURING THE THREE MONTHS ENDING FEBRUARY 26, 1900

In this, the first issue of the Bulletin, only preliminary suggestions and directions regarding the exchange of products and geographic material can be given. These directions will be found on the preceding page, in the report of the Chairman of the Committee on Exchanges. Members interested in this work should communicate with the Chairman of the Committee or with the Director of the Bureau, sending samples and descriptions of material. To have specimens examined and approved before being listed for exchange is clearly an advantage, since it will help to prevent disappointments as to the kind of material received. Hereafter, approved illustrative material will be published in a list by itself. A large number of those members who have indicated their desire to exchange specimens will doubtless appear on this approved list in our next issue. In the following list, a marginal * indicates ability and willingness to exchange photographs of neighboring geographic features; and a marginal † indicates the same for characteristic products. Those who offer to exchange both geographical views and characteristic products of their vicinity, are indicated by a marginal *†.

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UofM

AN ADIRONDACK STREAM.—Page 124.

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BULLETIN

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FREE-HAND MAP WORK

BY J. PAUL GOODE, STATE NORMAL SCHOOL, CHARLESTON, ILL.

The best way to become a connoisseur in an art, is to learn the ins and outs of the art—to become an artist. Then, knowing the limitations of materials, and the value of the human element, safe judgments can be made and the work of others properly appreciated. The head of a great business needs to know the details of every part of the business, and, to prepare himself for proper judgments in all cases, sets himself to learn each man's work by doing it. In no other way could he become the master mind in the business.

In geography we are constantly using maps,—maps of all scales and diverse methods of projection. The engraver has done his work well or ill, as the case may be, but it is upon the maps, such as they are, a necessarily large part of our work in geography must be based. So proper education in geography must include a careful training in the making and interpretation of maps. More and more a map is coming to be a method of shorthand representation of a mass of geographical information, and more than ever a good geographer is able to read a chapter from a map.

In America we are satisfied with a quality of map much inferior to what is common property in Germany. But we get all we ask for, and so long as we are content with poor quality we need not hope to have better quality thrust upon us. When we are able as a people to discriminate between our inferior maps and the fine

work of the Germans, we will demand and get something better. Every bit of attention we can focus on the subject of maps will help to this end. But to be ready to understand a fine map one needs some experience in the making of maps, even if not so fine. The pupil, to be map-wise, needs to make maps, to understand the theory of projections, to be much with maps; to linger over them lovingly and to observe them carefully; to store away in memory exact pictures of many space relations; in short, to learn the language of maps, and then to memorize some of the essays and sketches (maps) set forth in that language.

It is in this part of his training that the business of free-hand map drawing from memory has its value. Every pupil on leaving the grades should have a tolerably clear mental picture of the main outlines of the continents and the states in our Union, with their most prominent physiographic features. The most natural method of expressing such knowledge is by a free-hand sketch map from memory. It is with the hope of helping teacher and pupil in this narrow but important phase of geographic education that this article is written.

Let me utter a protest in starting, against the notion that map drawing is hard, or that one must be born to it to do it. That is all nonsense, and the boy whose mother tells him that he can't draw maps, because she couldn't, and her father couldn't, and that it doesn't "run in the blood" in her family to draw maps, is indeed under a heavy handicap. It needs to be clearly seen, that to draw the essentials of a map, is, as a rule, as easy as to make a capital letter, and that the people who have not brain power enough for such a task are defectives, and have no place in the open public school.

A careful attention to the working of our mind in learning the details of a map, is a clue to the method to pursue in the study and reproduction of map forms. The mind sees space relations in simple ratios. One object is twice or thrice as long as broad, or four fifths as wide as long. If the numeric is not higher than six, most people will name it in the comparison, without effort, at the instant of observation. The expressions, "a little longer than broad," and "a little more than half," are efforts to state ratios we recognize, but are not able to name definitely. The comparison is made, however, and can be easily represented to scale in the graphic form, tho not named.

Now if we know how the mind works, we need lose no time in formulating a method of study and putting the mind into normal action. Let us take an example of a map full of difficulties and of detail which must be attended to in order to express ourselves in chalk. The little group of central states, Illinois and her neighbors on the east and west, will be a good one. Start with the north line of Iowa. The length assigned it will determine the size of the map. It becomes a base line of construction. Three-fourths of its length measures the distance to the north boundary of Missouri. The west end of this Missouri line, lies a distance equal to one-eighth of the length of the base line east of the west end of the base line. The Big Sioux and Missouri rivers form almost a straight line between these two points.

The eastern boundary of Iowa is made essentially of three great bends in the Mississippi river: the upper third, the river flowing almost due south, but bending east; the middle third, a broad convexity to the east; the lower third a general trend southwest.

The Missouri river, from the northwest corner of Missouri, advances S. S. E. and serves as a boundary a distance equal to one half the north line of the state, and at a point south of the end of the first quarter of that line measured from the west the meridian begins which forms the rest of the western boundary. The total length of the state from north to south is one and one-half its north line, and this is exactly the measure of its width on the south line.

The Mississippi river, from the mouth of the Des Moines, advances with a general trend S. S. E. to its junction with the Ohio, at a point about one-fourth of the south line of Missouri, northeast of where that line would end were it carried to the Mississippi river. Here the river trends abruptly south-southwest. The sharp bend where the Missouri joins the Mississippi is one-half way down this east boundary of Missouri.

At a point one-third of the way down the state of Iowa the north line of Illinois starts east, running to Lake Michigan, a distance exactly equal to one-half the width of Iowa at this latitude. From the east end of this line the lake shore bears south and gently east, finding the west line of Indiana at a point south of the north line of Illinois, a distance a little less than half this north line. This meridian continues south to the Wabash, a distance

exactly equal to the north line of Illinois. The Wabash and Ohio bear south and gradually west, till the junction with the Mississippi is found at a point due south of the mid-point of the north line of the state.

And so the study runs on, every essential detail of the map related in simple terms to known elements in the map and all tied together into a unity called a state, or a continent, as the case may be. The method of study once grasped is applied to any form, and the number of details necessary to keep conscious track of, decreases with experience and practice. But it must be remembered that, consciously or unconsciously, the mind *must make* these comparisons and relations, and in no other way can an artist draw a landscape or a portrait, or a geographer a map. Nor is this list of relations to be noted, a burden. The elements go together in a fixed way. They do not change. Really, it is an exercise of attention and retention not unlike that in memorizing a paragraph of prose or, even easier, a verse of a poem.

In the map study above, I have gone into detail to show how the mind works in apprehending and remembering space relations. It seems long written out, but the study is made, the observations taken in a very short time, and they can be seen in a very small fraction of the time it takes to enumerate them.

Studied in this way the continents become as easy as so many letters in an alphabet,—learned once, learned forever. Outlines once mastered, a wealth of detail, physiographic, political, commercial, is easily, fluently shaded or lined in, so adding immensely to the power of expression of the pupil and to the power of presentation of the teacher. Facility with the chalk is one of the greatest accomplishments a teacher may have. It adds much to his power to be able to sketch rapidly and accurately the region under discussion, and to make a diagram, or even a picture, of the thing under consideration. And there is no royal road to this vantage ground. Success lies only along the line of doing. The smith by smithing becomes a smith. Brains must be mixed with the work. Errors must be sought out and corrected. An error once discovered, it should be considered a mental crime ever to go that way again. The essence of wisdom, to quote an aphorism from Dean Judson, consists not in never being a fool, but in never being the same kind of a fool twice.

This line of work has high teaching value. It trains in care-

ful observation, compelling attention to essential relations and details not otherwise noticed. These details could be noticed in a study of a map and no drawing ever be done. But apprehension is not necessarily comprehension. The proof of the pupil's ability to see is in his ability to reproduce. Writing maketh an exact man, according to Bacon; the map sketch is the written statement of what was seen and comprehended. Drawing maketh the exact pupil.

The drawing fixes in memory the essential relations as nothing else can. The pupil puts more on the board than he dreams. He sets down in chalk, a plain statement of his ability to observe, to grasp relations, and to give a truthful report of his observations. It is an open confession of the quality of his mind. He will give as lucid a report of the map studied as he will of the principle expounded, or the topic discussed.

One of the strongest features of this work is the training it gives in concentration and continuous attention. A pupil who can draw from memory a map of the United States, with outlines of all the states, all the capitals, an average of two or three rivers per state, several large cities not capitals, a half dozen mountain ranges, and the standard time meridians and boundaries, and have a good legible map in five minutes, must have a power of concentration beautiful to behold. There are very few opportunities in the school training where the pupil may be given such command of his powers.

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LOOKING UP THE HUDSON RIVER FROM WEST POINT

METHOD IN GEOGRAPHY

BY WILLIS E. JOHNSON, STATE NORMAL SCHOOL, MAYVILLE, N. D.

A teacher should have a better view of the common school subject geography than that which he gained as a student in the grades. He should know constructively the subjects which he teaches. This involves a point of view which overlooks each subject in its relations of whole and part, substance and attribute, and in its interdependence among other related subjects. Thus to know a subject constructively is to see it as made up of parts, to know the function of each part, to see the relations to the other parts and to the whole, and the organic whole in its relations to other subjects. But this, while it might seem complete, is not sufficient for the teacher; for it would be like a physician's knowledge of medicine without his understanding it in its relations to the human body. The real subject of education is the mind of the pupil, and it is to the mind that the subjects of instruction are to be adapted. Just as the physician adapts his medicine, directions concerning diet, exercise, etc., in the light of physiology, so the teacher adapts parts and phases of subject-matter to the mind of the pupil in the light of psychology. As in the past physicians prescribed for bodily cure and growth regardless of the physiological laws involved, so some teachers, trusting to blind instinct, attempt to stimulate and foster healthy mind growth, regardless of mind laws. To grasp method in geography, then, would be to know geography, to know psychology, and to see geography from the point of view of the *thinking of geography*. This would be a constructive knowledge of the subject.

How is the teacher to determine what truths or phases of truths belong to geography, and their relation to the subject as a whole? What will determine the divisions of the subject and their relations? How much physics shall be taught in physical

geography? Since geography is an organic unity it must have some principle of organization,[1] and such questions can be answered by a reference to that organizing principle. While the central truth of geography might be stated in various ways, the following would seem most adequately to set forth its fundamental thought: Geography deals with those truths which relate to the earth as it conditions and explains man's institutional life, placing immediate emphasis upon the business world. Guyot sums it up thus: "Geography deals with the earth as the home of man." Dr. Dewey says, "Geography deals with the interaction of man and nature."[2]

We observe from this that there are two phases to the subject. Its truths relate to the earth, and to man as an institutional being. In the former aspect the subject is brought into close relations with natural sciences dealing with the earth; such as geology, astronomy, physics, and biology. In the latter phase it is closely allied to other subjects relating to man's institutions; such as history, civics and sociology. Space will not permit an adequate discussion of the relations of geography to the above named subjects; but we venture the assertion, which is no doubt rank heresy, that geography is more closely related in meaning to institutional subjects than to natural sciences.

Geography, tho dealing with physical elements, does not treat them as such alone; for example, the study of plant life and growth lies wholly within the province of botany, while geography deals with plants as determined by physical conditions, and as determining commerce and other institutional conditions. While the subject-matter of geography deals with nature and human nature, and is employed more with the materials of the former than of the latter, it is always faced one way—toward man. The student of geography in the Red River Valley (north) studies the geologic history of these plains in order to explain the conditions offered the industrial world. The purpose of this temporary facing toward nature is not so much to understand nature as to explain society, that is to say, to get eyes with which to see and interpret correctly the human aspect of the region.[3]

Tho geography is one and inseparable, it may be thought into the logical divisions, mathematical, physical and political. This division is made on the basis of the aspect in which the earth is

[1] Consult references on pages 110 and 111.

viewed. In mathematical geography the earth is viewed as a planet; and the culminating truth of this phase, toward which all its other truths point, is the earth divided into astronomical heat belts.[4] In physical geography the earth is viewed as an organism; and the geographical elements, land, water, air, and physical products, and the geographical processes, winds and currents and other movements among the elements, are studied as they are interrelated and form the material basis for the life of man. In political geography the earth is viewed as the theater of man's action, and its central truth may be said to be man's use of the earth.

Such parts of geography as physiography, historical geography, etc., are made upon some accent which is given to a particular phase of the subject as a whole, and which embraces parts of some other subject. In physiography, that part of physical geography which treats of the relations of geographical processes to relief form is carried out until, to complete its thought, it invades the field of geology. Physiography, the science of land structure and sculpture and the evolution of surface relief and soils, comprises much of the work in physical geography.[5] Cartography, moulding and such other arts employed in geography as a means for expression, extend thruout the subject as essential devices for the expression of geographical concepts.

Summing up this which we may term the logical view, or the view of the subject taken by one who has organized it: The earth, its elements and processes, determine physical products; and these together with commerce and the various industries of life, form the woof of the fabric of society. The earth, man's home, furnished partly by nature and partly by art, to be used by man for man, thru natural and human relations, becomes the basis of the expression of Divine Idea.

What can geography do for the child?[6] It is the first subject he studies which treats of man and new regions and new life. It is the key which opens to him his relations to his fellows. By it he becomes acquainted with his larger home and family, for in these days of rapid transit and communication the whole world is man's home.[7] Thru geography the child first learns that "He is a member of a joint stock company which owns an estate twenty-five thousand miles in circumference and extends from pole to pole. Each individual is related to the entire estate. * * * * Geography

teaches the individual that his labor and his locality are no private affairs, but that the entire world is interested in them. * * * * Geography gives to a man a knowledge of himself, by teaching him the infinite web of his relations extended in space."—*Joseph Carhart.*

"All substance to support life and create wealth comes from the mother earth and is developed and distributed by the hand of labor. * * * * Agriculture, manufacturing, and commerce are the three great links in the chain of industry. The farm, the elevator, the railroad, and the mill are all interested in each other and are partners, regardless of how they may agree."—*Budd Reeve.*

Seasons, winds, rainfall, relief form, soil, products, and industries are not geographical topics unless they are studied in their interrelations as they make a home for man and form the basis for his union in business, the division of labor, and the building and maintaining of society.

Thru geography the pupil learns that men are dependent upon each other, and that this interdependence thru business society is the basis of his growth, and objectively, or from the standpoint of results, it is governed by the Divine law of love. "Let no man seek his own but every man another's wealth." By these interrelations, man is enabled to fulfill the injunction to subdue the earth and have dominion over it. Accompanying this sociological value is its important and hardly secondary scientific value, giving the child a view of nature essential to a correct view of society, an insight into the stream of natural causation in which he finds himself.[8]

THE NATURE OF GEOGRAPHY WORK FOR THE FIRST THREE GRADES

There is no more reason for deferring a sequential study of geography until the fourth grade when the pupil can easily read and consequently use a text-book, than there would be for a like postponement of a study of arithmetic. During the first three grades, three more or less distinct lines of work should be pursued and gradually developed.

Part I. The pupil should acquire a conception of the earth as a whole, seeing it in its most general aspect as having certain general attributes and distributions, such as form and motions, variation in climate, surface relief, land and water areas, life and

occupations of people. This will be accomplished largely by imaginary journeys[9] after the plan of "Seven Little Sisters," and "Each and All."

Part II. The pupil should form concepts of geographical elements and such geographical phenomena as come within his experience and environment, and constitute an apperceptive basis for other geography work. Forming general notions of geographical elements is usually left to the accidents of the child's culture environment. This is a mistake. It is little short of criminal to permit children to pass thru the common school, as they so often do, without ever clearly seeing the difference between Congress and the White House, not sure whether the moon rises in the west or in the east—in other words, not knowing that the earth rotates, and for whom the simple method of reckoning latitude and longitude, the phases of the moon, the cause of dew, and the simplest physiographic and meteorological phenomena are unknown mysteries. A teacher once remarked to the writer after he had attempted to answer her questions relative to a sand dune on a delta of the ancient glacial lake Agassiz, "Oh! I thought it was the work of nature." From which remark a cruel inference was drawn as to her conception of "the work of nature." The following outline briefly suggests the character of the work under this part.

1. Concepts of geographical elements such as lake, river, mountain, plateau, delta, etc. Mental steps: *a.* Observation of a concrete individual or that which will best typify one. *b.* Imaginary visits to other individuals. The order to be observed in the selection of examples should be the order of nearness to the child's experience, which may or may not be the order of distance. It may be that the Nile river will be more easily understood than a river in an adjoining county. Those who arrange courses following the order of nearness in space proceed on the naive assumption that an object one hundred miles away is more easily conceived or imagined than one two hundred miles away. *c.* Following the discussion of individuals, such generalization as includes the essential attributes, so that the word calls up a definite notion.

2. Weather observation.[10] Winds observed daily, prevailing wind noted, and direction of wind associated with temperature and humidity of air. Seasons as marked by plant and animal life and occupations; preparation for winter: leaves falling, birds depart-

ing, heavier coat of hair on horses, etc. Seasons associated with position of heavenly bodies, especially the sun by noting the length of days and of shadows.

3. Institutional life. *a.* Business. Occupations of people, division, necessity, and nobility of labor. Means of communication and transfer of goods. Stories of industry, how gold is obtained, how a pin is made, etc. *b.* Government. The concept government, its necessity (not merely in the negative sense of protection from the deeds of evil doers, but of the administrator and adjuster of public affairs). Government noted first from the executive side. The concept United States probably formed first after some more or less definite notion of the administration of the school, home, and some local affairs. Child forms the notion United States thru the idea president, wars, foreigner, legal holidays nearly all national. *c.* Universality of churches noted. *d.* Different homes studied as suggested in Part I.

4. Miscellaneous. Ideas of direction, distance, form,[11] etc., will be obtained in connection with arithmetic, drawing, and in much of the work suggested in this outline.

Part III. Pupil should acquire the ability to read and make maps and use other devices for geographical representation. Maps are media for expression of geographical data, and, to have their full educational value, need special attention.

The foregoing work need not further crowd the curriculum for the elementary grades. It will constitute a large part of the so-called nature study, and it is suggested that instead of the nonsense so often employed for language drill, devoid of meaning or interest, may be substituted language work having to do with living truths of nature and society observed and studied.

Without making any attempt at forming a bibliography of this subject, the writer would call attention to the following references.

[1] For an excellent discussion of the central principle of the subject, the reader is referred to an article by Dr. Charles McMurray, in the *Educational Review* for May, 1895. Another phase is emphasized in able articles by Dr. Charles Dryer, in the *Inland Educator* for February and September, 1897.

[2] *Third Year Book* of the National Herbart Society.

[3] The physical basis of political geography is lucidly presented and illustrated by Professor W. M. Davis, in the *Educational Review* for May and June, 1892.

[4] "Lessons in Mathematical Geography, by Dr. S. Y. Gillan, Milwaukee."

[5] The modern meaning and application of physiography is succinctly

stated and illustrated by Jacques Redway, in the *Educational Review* for November, 1895.

[6] See "The Educational Value of Natural Science," by Professor Woodhull, in the *Educational Review* for April, 1895.

[7] "The Universal *vs.* the Particular in Education," *Public School Journal*, October, 1892.

[8] For helpful discussions of mapping and moulding see "Surveying and Mapping," by Dr. Dryer, in the *Inland Educator* for June, 1898; an article on text-books by Jacques Redway, in the *Educational Review* for February, 1893.

[9] For an excellent presentation of the imaginary journey see the series of articles on that subject by Professor McCormick, in the *Public School Journal*, beginning December, 1897, and reprinted in book form by the Public-School Publishing Company, Bloomington, Ill.

[10] For suggestions see an article by W. P. Shannon, in the *Inland Educator* for October, 1897. Teachers in more advanced grades will find very helpful a little pamphlet "Weather Maps and How to Use Them," by Professor G. D. Swezey, published by J. H. Miller, Lincoln, Nebraska.

[11] Other references on the organization of the subject. Geographic Monographs, especially the one on professional geography, by Professor Frank E. Mitchell, Oshkosh, Wisconsin. "The Geospheres," by W. J. McGee, in the *National Geographic Magazine* for October, 1898. Some excellent papers on "Geography in the Grades," from the virile pen of Dr. Dryer, have appeared from time to time in the *Inland Educator*.

ORGANIC GEOGRAPHY

BY LOUISE MILLER, ITHACA, NEW YORK

The object of this paper is to show how science, literature, art and music have been related in school work. The central subject is geography, and the rest of the work is included under science, language, reading, literature, drawing, painting, number, music and art, and is supplementary. The work outlined can only be accomplished as a whole under favorable conditions, and many teachers will consider it impracticable. It may be suggestive to all.

Part of the work outlined for the seventh grade by Miss Scott in her book, "Organic Education", is stated thus: "The children are now ready to study more minutely the life history of the earth in a scientific spirit and with special reference to the industrial evolution of man. They study the history of the planet, the structure of the land portions of the earth, drainage, climate, and

both those productions that are native and those introduced by man. The underlying idea of this study is the unity and organic inter-relationships of the physical earth, with a view to bringing out the same principles in the succeeding studies of the industrial and social world." This work should be taken after the children have made a study of the continents, and must be based upon nature study work which has been given in the lower grades. The way in which this course has been presented may be of interest to teachers who may desire to pursue it. The work as far as possible should be experimental. The aim should not be to force conclusions, but to give the children as much experience as possible in order that they may be able to make their own judgments and generalizations, based upon actual observation. The work undertaken is broad and comprehensive, and it may appear very superficial; but the children took much of the work in other grades in different relations. The work in this grade was organization — putting things in their proper relations. The fundamental idea is the gradual development of the mineral, plant and animal worlds as recorded in the rocks, exemplified in existing species, described in literature, expressed in art, and sounded in music. It would be impossible to go into the details of the work, and only the salient points are here suggested.

The generally accepted nebular theory was presented and made as vivid as possible. The elements which composed this mass were discussed, and we *made* oxygen, hydrogen and nitrogen because they are so widely distributed in earth, air, water and protoplasm. Their properties were compared with carbon dioxide which was found in the experiments with oxygen. Reference was made to their own experience in breathing, etc.

Water was taken to show that matter can exist in three states, solid, liquid, and gaseous, and that these states depend upon temperature. Experiments showed that heat caused solids, liquids, and gases to expand, and cold caused them to contract. These phenomena were also used as a basis for the study of winds, ocean currents, and disintegration of rocks. Pupils reasoned that the nebula, when very hot, was highly expanded, and that it contracted as the heat radiated. Gravitation and centrifugal force were taken in connection with the throwing off of the nebular rings which formed the planets. In the study of that period of the earth's history during which the crust of the earth was formed and

became cool enough to allow water to remain upon the surface, we took up a study of water evaporation and condensation in relation to the formation of rain, rivers, lakes, and oceans.

The next step was a study of igneous rock pressure. Specimens of contorted gneiss showed folding—the result of pressure. Coarse and fine crystals in the different varieties of granite, and characteristic crystals of its chief constituents—quartz, mica, and feldspar—were compared.

To show there is a law governing crystalization, we made crystals of copper sulphate, alum, salt and sugar; cooling some solutions very rapidly and allowing others to form very slowly, we secured crystals similar in shape but not in size.

Natural laws are immutable and universal. They are the historians of the past and the prophets of the future. If certain forces are acting today producing certain results, it is fair to suppose they always have and always will produce the same results. The action of the physical and chemical erosion upon the exposed igneous rock, resulted in the stratified rock, which was genetically from igneous, stratigraphically upon it, and geographically around it. Space forbids going into the details of the experiments, but the children saw that rock could be formed from material in suspension or solution. Limestone and sandstone were compared as to their chemical and physical characteristics and their readiness to yield to erosive agents. Chemical erosion was related to the formation of caves. They saw that water on a level surface stood still, had a slight velocity on a gentle slope, and an increased velocity on an increased slope. They deduced the conclusions that the greater the gradient the greater the velocity, and the greater the velocity the greater the wearing and carrying power, and the converse. These experiments helped to explain sculpturing in plateau regions, building of flood plains, and deposition of material in the sea. Knowledge gained by actual experience and based upon scientific facts, is an open sesame to every geographical condition whether it be the flood plains of the Po river, the canon of the Colorado, or the Mammoth cave of Kentucky.

The children were led to see that the evolution of animals and plants could be studied horizontally in existing species, and vertically as they are recorded in the rocks. Types of animals and plants were taken showing the gradual development of organisms, and their adjustment to their environment. We did not begin

with the simplest forms of life, as the children had taken some of them the year before. We began with the algæ and coral, and modern coral was compared with fossil species. We visited the museum, and examined a fine collection of coral from the Philippine Islands, using this information in our study of the formation of coral islands. The algæ were related to the formation of carbonaceous shale, and bituminous matter found in the rock of the stone quarry which the students visited. The algæ and fungi in their symbiotic relation in the lichens were taken as great disintegrating agencies and soil producers. We studied the brachiopods and other ancient species with allied forms of existing species. Some of the fossils found in the limestone presented the occasion for the study of mollusks. We observed land and water snails, and dissected oysters and clams. To broaden our conception of this branch of the animal kingdom we availed ourselves of the fine collection of shells in the museum. The exquisite coloring, beautiful forms and protections, were carefully noted; and the differences between land and water, shallow and deep sea shells were contrasted.

The children saw that all creation is divided into organic and inorganic matter, and that the mineral matter is organized by plants, and plants by animals, and that by disintegration they revert to the mineral world; that every organism has two functions —taking nourishment and reproducing its kind; that the first is selfish in the highest sense, striving for perfection that the ideal may be transmitted to the offspring. The moral force of such teaching cannot be estimated. Children begin to appreciate and reverence their own bodies, and conserve their energy, in order to accomplish the purpose for which they were created.

As types of existing species of animals, we considered the sponge, coral, starfish, earthworm, clam, snail, crayfish, insects, turtles, snakes, frogs, fish, birds, mammals, and, excepting the first three, examined live specimens. Careful study of these animals had been made in the lower grades, and the work of this grade was the summing up of work already accomplished. By using pictures, fossils or casts whenever possible, existing types were compared with extinct forms, and likenesses and differences noted. The plants were taken in the same way, and mosses, ferns, and equisetum were studied in connection with the carboniferous period. The general characteristics of the reptiles and amphib-

ians of this period were compared with those of the present day. The birds and insects were also studied in their development and their relations to the plant conditions of that time.

In one of our field lessons we observed that the fallen trees and leaves were decaying, and that those exposed to the air were disintegrating more rapidly than those in the streams and pools. The study of plants and animals during previous years led the children to see that all color, form, perfume, texture, and song were closely related to food-getting and reproduction. These characteristics belong to a higher order of creation, and the lower forms are stages in a divine order, which culminates in the two most perfect representatives of the plant and animal kingdoms—a tree and a man.

In taking up the glacial period, we reviewed evaporation, condensation, and crystalization. The size and variety of crystals were related to the amount of moisture in the atmosphere and temperature. The children had "shadow sticks" and once a week recorded the varying length of the shadow cast by the sun at noon. The atmospheric conditions and the active or dormant conditions of plants and animals depend upon the amount of heat received by the earth from the sun and given off into the atmosphere. A daily weather record was kept of the day, date, frost or dew, clouds or fogs, rainfall, temperature, barometer, sunrise, sunset, moon's phases, moon rise and moon set, and morning and evening star.

The influence of the glaciers in North America was noted in change of temperature and of drainage systems, location of many lakes in glaciated regions, the great number of glacial boulders, and certain striations found in the limestone rocks of a quarry we visited. The quality of the soil of the region stretching west and north from the Atlantic ocean, and north of the Ohio and Missouri rivers, is largely due to slow grinding of masses of archæan rock, which were broken off by glaciers in their southward movement and deposited when the glaciers retreated. This region is of great fertility, and one of the most productive grain districts in the world. The present contour of the country should always be referred to previous geological conditions, and all knowledge should have a scientific foundation. The children appreciated the fact that the study of geology is the study of a succession of geographies; that geography is the present aspect of the earth—land areas, water

areas, characteristic animals and plants; that each geography was the result of certain forces; and that the present conditions were the culmination.

Whether the earth was made for man or not, it was well made for that purpose. The commercial, industrial, and social evolution of man depends upon the physical evolution of the universe. Mining depends upon the geological deposits of minerals; agriculture, upon the contour of the country and fertility of the soil; commerce, largely upon the drainage systems; manufacturing, upon water and coal supply; and the very nature of man himself depends upon characteristic areas of territory on which he chances to be placed. The Nile valley developed one kind of civilization; the mountains of Greece, an entirely different kind. The structure of New England gives rise to characteristic industries. The same is true of the southern section, of the great plains, and of the mountainous regions.

Civilization may be regarded as man's power to overcome his environment. After he has conquered physical nature, he has power to look deeper and find the higher, spiritual significance. The highest and best in man's nature are expressed in music, literature, and art. Those who have expressed best, have been close students and lovers of nature. Only those who are students and lovers of nature can interpret and appreciate the best in music, literature and art. Feeling that the experience and training the children had received made it possible for them to appreciate the best in art, we presented the choicest material. For music we took the oratorio of the "Creation," by Joseph Haydn. While we were studying the nebula, the children heard the overture to enable them to know how chaos could be expressed in music. After the earth's crust was formed, and the water remained upon the earth, the battle of the giants (earth, air, and water) began. As appropriate music to accompany the study of this period of the earth's history, we chose the bass solo from the "Creation"—"Rolling in Foaming Billows."

"Rolling in foaming billows,
Uplifted, roars the boisterous sea.
Mountains and rocks now emerge,
Their tops among the clouds ascend,
Thru the open plains, outstretching wide,
In serpent error rivers flow."

When studying of the first appearance of plant life on the earth, we had the soprano solo, "With Verdure Clad."

"With verdure clad the fields appear,
Delightful to the ravished sense;
By flowers sweet and gay
Enhanced is the charming sight.
Here fragrant herbs their odors shed;
Here shoots the healing plant;
With copious fruits the expanded boughs are hung;
In leafy arches twine the shady groves;
O'er lofty hills majestic forests wave."

Our chorus of about one hundred and fifty children and students, also sang the chorus,—

"The heavens are telling the glory of God.
The wonders of his work displays the firmament."

The aria, "On Mighty Pens," for soprano, was sung in connection with the study of birds.

"On mighty pens uplifted soars
The eagle aloft, and cleaves the air
In swiftest flight, to the blazing sun.
His welcome bids to morn the merry lark,
And cooing calls the tender dove his mate.
From every bush and grove resound
The nightingale's delightful notes;
No grief affected yet her breast,
Nor to a mournful tale was tuned
Her soft, enchanting lay."

With the study of animals may be sung the bass solo:

"The earth obeyed the word,
And teemed with creatures numberless,
In perfect forms, and fully grown.

Cheerful, roaring, stands the tawny lion. With sudden leap
The flexible tiger appears. The nimble stag
Bears up his branching head. With flying mane,
And fiery look, impatient neighs the noble steed.
The cattle, in herds, already seek their food
On fields and meadows green;
And o'er the ground, as plants, are spread
The fleecy, meek, and bleating flocks.
Unnumbered as the sands, in swarms arose
The host of insects. In long dimension
Creeps, with sinuous trace, the worm."

To mark the period when man appeared upon the earth, we had the tenor solo: "And God created man in His own image."

" In native worth and honor clad,
With beauty, courage, strength, adorned,
Erect, with front serene, he stands
A man, the lord and king of nature all.
His large and arched brow sublime
Of wisdom deep declares the seat!
And in his eyes with brightness shines
The soul, the breath and image of his God.
With fondness leans upon his breast,
The partner for him formed,
A woman, fair and graceful spouse.

The music was furnished by experienced singers who were willing to give the children the pleasure. The chorus was under the direction of one of the teachers. The life of Haydn and his works were also studied.

The literature was very interesting. The first selection was the Bible Story of Creation, and the paraphrase of the Nineteenth Psalm.

" The spacious firmament on high,
With all its blue ethereal sky,
And spangled heavens, a shining frame,
Their great orginal proclaim.
The unwearied sun from day to day,
Does his Creator's powers display,
And publishes to every land
The work of an Almighty hand.
Soon as the evening shades prevail,
The moon takes up the wondrous tale,
And nightly to the listening earth
Repeats the story of her birth;
Whilst all the stars that round her burn,
And all the planets in their turn
Confirm the tidings as they roll
And spread the truth from pole to pole.
What tho in solemn silence all
Move round the dark, terrestrial ball,
What tho no real voice nor sound
Amid their radiant orbs be found,
In Reason's ear they all rejoice,
And utter forth a glorious voice
Forever singing, as they shine,
The hand that made us is Divine."

When we were studying crystals we read parts of Ruskin's "Ethics of the Dust." "The Cloud" by Shelley, and "House of Clouds" by Mrs. Browning, were taken with the subjects evaporation and condensation. "The Fossil Fern" was taken with the study of the Carboniferous period.

THE PETRIFIED FERN

In a valley, centuries ago,
Grew a little fern-leaf, green and slender,
Veining delicate, and fibres tender;
Waving, when the wind crept down so low.
Rushes tall, and moss, and grass grew round it,
Playful sunbeams darted in and found it,
Drops of dew stole in by night and crowned it.
But no foot of man e'er trod that way;
Earth was young and keeping holiday.

Monster fishes swam the silent main,
Stately forests waved their giant branches,
Mountains hurled their snowy avalanches,
Mammoth creatures stalked across the plain;
Nature reveled in grand mysteries,
But the little fern was not of these,
Did not number with the hills and trees;
Only grew and waved its wild, sweet way,
No one came to note it day by day.

Earth, one day, put on a frolic mood,
Heaved the rocks, and changed the mighty motion
Of the deep strong currents of the ocean,
Moved the plain and shook the haughty wood,
Crushed the little fern in soft, moist clay,
Covered it and hid it safe away.
Oh the long, long centuries since that day!
Oh the agony! Oh life's bitter cost
Since that useless little fern was lost!

Useless? Lost? There came a thoughtful man,
Searching Nature's secrets, far and deep;
From a fissure in a rocky steep
He withdrew a stone, o'er which there ran
Fairy pencilings, a quaint design,
Veinings, leafage, fibres clear and fine,
And the fern's life lay in every line!
So, I think, God hides some souls away,
Sweetly to surprise us, the last day.

MARY BOLLES BRANCH.

"The Ocean" by Byron is appropriate in connection with the study of the ocean as a geological and commercial factor. "Nature's Chain," from Pope's "Essay on Man," and also "Harmony in Nature" by Jones Very, were taken with our study of unity in nature. "The Chambered Nautilus" by Holmes was taken with the study of this animal and its long line of fossil ancestors. Boys enjoy "The Combat with an Octopus" by Victor Hugo. "The Story of a Stone" by David Starr Jordon is a delightful story with the study of coral. There is such a wealth of literature a selection is difficult. The following would be appropriate for the class or for suggested literature:

John Ruskin—Clouds and Mist at Sunrise; Stones of Venice.
John Tyndall—The Influence of the Sun.
Tennyson—The Brook.
Shelley—Ode to the West Wind.
Southey—How the Water Comes Down at Lodore.
Lowell—The First Snow Fall.
Bryant—Thanatopsis; To a Waterfowl; The Blue Gentian.
Eugene Field—Little Volume of Profitable Tales.
Hamilton Mabie—Under the Trees.
Thoreau—Walden; Spring, Summer, Autumn, Winter; Excursion to Field and Forest.
Burroughs—Locust and Wild Honey; Winter Sunshine; Birds and Poets.
Longfellow—Autumn; Woods in Winter; Reaper and Flowers; Building of the Ship.
Whittier—The Corn Song; The Huskers; The Drovers; The Lumbermen.

MYTHS

Apollo, Atlas, Niobe, Mars, Mercury, Jupiter, Venus, Aurora.

The work was much enhanced by the use of good pictures. The teacher used rare taste and judgment in her selection of pictures, casts, and bas-reliefs for school decoration. The children were familiar with artists and their productions, and were ready to make appropriate selections from the best. These were used for decorating their calendars, weather records, and for illustrating their note-books. The photographs were used to familiarize the children with the faces of men and women who had accomplished

something in the world's history; the plants and animals to give them ideals; the architecture to show the use man has made of the great store-houses of nature. Aurora was taken as the dawn of creation. The following is a list of suitable photographs, paintings, and statuary:

PHOTOGRAPHS

Musicians—Haydn, Mozart, Handel, Mendelssohn, Wagner.
Scientists - Darwin, Huxley, Franklin, Agassiz, Edison.
Artists - Rosa Bonheur, Millet, Corot, Raphael, Landseer.
Authors– Ruskin, Byron, Shelley, Longfellow, Whittier.

PAINTINGS—CREATION

God dividing the light from the darkness; the creation of the dry land; the creation of the sun and moon; the creation of animals.

Burne-Jones—Spring, Summer, Autumn, Winter; Days of Creation.

Raphael– Days of the Week; Hours.

PLANTS AND ANIMALS

Corot—Landscapes; Orpheus and Eurydice; Diana and the Bath.

Claude Lorrain—Landscape.

Rosa Bonheur—Horse Fair; Ploughing; Lions at Home; Landais Peasants.

Landseer—My Dog; A Deer Family; The Sick Monkey.

AGRICULTURE

Millet - Angelus; The Sower; The Gleaners; The Man with the Hoe.

Breton—End of Labor; Song of the Lark.

ARCHITECTURE

Pyramids of Egypt, St. Peter's Cathedral, Notre Dame, St. Paul's Cathedral, Capitol of United States.

STATUARY AND BAS-RELIEFS

Winged Victory, Venus de Milo, Apollo, Mercury, Singing Boys, Seasons.

Each child should keep a note-book, describing experiments, drawing apparatus, and making records which are desirable. Outline maps may be duplicated on a mimeograph, and climatic belts, rain areas, distribution of mineral deposits, vegetation and animals can be indicated in color. The agricultural, commercial and industrial districts can be indicated in the same way.

Good pictures[1] are so cheap, and current literature so well illustrated that by judicious selection a good collection of pictures is within the grasp of each child. The taste of individuals is made apparent by such choice, and by proper guidance a child may soon be led to appreciate what is best.

When we realize how very few of these children ever reach the University or High School—that seventy-five per cent. never get beyond the fifth grade in school—we should try at least to give them a taste of the good things of the world. Omar Khayyam, the Persian philosopher, said:

> I sent my soul thru the Invisible
> Some letter of the after-life to spell;
> And by-and-by my soul returned to me,
> And answered, "I myself am heaven and hell."

If we open the book of nature, the pages of history and literature, the portfolios of art and music, may we not make it possible for the children to live in heaven upon earth?

[1] The Perry Picture Co., Malden, Mass.

CONCRETE GEOGRAPHY *

BY CHAS. F. KING, MASTER OF DEARBORN SCHOOL, BOSTON

The following definition is taken from a primary geography: "A large stream of fresh water flowing thru the land is called a river." In a newly published geography we find this statement: "The Hudson river is one of the principal arteries of commerce in the United States." Truth thus stated in the abstract makes little impression upon the young mind compared with that produced when, for instance, a particular river is made a real thing by the

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TEAR OF THE CLOUDS.

* Copyright by Chas. F. King, 1900.

teacher's lively description aided by maps and pictures. Let us take up the Hudson river by way of illustrating this theory.

THE HUDSON RIVER

Its Sources. One of the most interesting trips which I have ever taken, children, was from the mountains to the sea in the state of New York. One day I found myself with a party beside a lovely lake on the side of a very high mountain, far from human habitation. Our guide informed us that the little lake is called the "Tear of the Clouds," and the mountain, Mt. Marcy, or as the Indians call it, "The Cleaver of the Sky." It was extremely interesting to me, because I learned that this little lake is the highest source of the noble Hudson, four thousand feet above the level of the river's mouth. Its mirror-like surface reflected the stars, or glistened behind the veil of clouds, while the great peaks looked down upon the ice-cold waters.

Making our way around the margin of the pond, we soon came to a beautiful little stream flowing into this body of water. This was so small that we could easily step across. On the other side was the outlet which we followed down a little way, noticing its rapid movements over the rocks. Several other brooks were seen on our way back to the hotel on that lovely July afternoon. One of these streams cut deep channels thru the solid rock where the slope was steep enough to cause a rapid current; another was wide enough to make us glad of a log over which to cross to the other side. (Frontispiece.) We descended nearly two thousand feet before reaching our hotel in the deep and narrow valley.

A VALLEY NEAR THE UPPER HUDSON.

THE CAMP BY THE RIVER.

The great area of forests, lakes, streams, mountains and valleys, called the Adirondacks is very dry and balmy, and so fascinating that it has many lovers who come every summer from different parts of the country to enjoy its attractions and share its benefits.

Upper Course.—Further wandering about in this vicinity made us well acquainted with the little brook flowing from the lofty pond into Opalescent river, so-called because the color is in many places like the opal. This river unites with others from different lakes and forms the north branch of the Hudson. We visited some of these lakes and found them of various shapes, surrounded by deep forests in which we saw and heard all kinds of wild animals. Squirrels, partridges, wolves, foxes, deer, and even black bears are quite common.

A LAKE IN THE ADIRONDACKS

Middle Course.—A few days later, we traveled in a carriage thru the Blue Mountain region—a land of lakes and brooks, and then on towards the southeast, crossing stream after stream uniting to swell the volume of the Hudson. During the last five miles of this trip, we rode thru a narrow valley beside the Hudson. We could frequently see the waters dashing along over the rocks in rapids and cascades. Near the railroad station at North Creek, we saw the river beginning its work of carrying logs to the mills below. In one place we saw the river rushing thru a long narrow defile in the hard rocks. Several miles below the defile, it receives a large tributary from the east, and fifteen miles below this, another and larger branch comes in from the west. These additions bring so much water that the Hudson becomes a strong and

powerful stream, and the logs are carried rapidly down to the saw-mills situated wherever falls are found.

One of the most beautiful of these falls is Glens Falls, where the river descends seventy feet in a variety of leaps and rushes,

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GLENS FALLS.

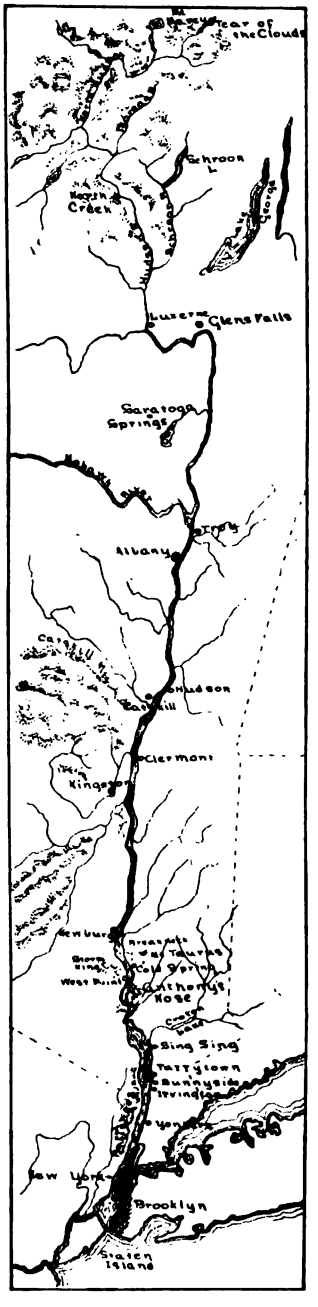
falling over black limestone rock. We spent several days in this lovely village, and each day I walked from the hotel a short distance down to the bridge, from which there was a grand view of the Hudson river, dashing and foaming, shooting and lashing, roaring and splashing over the ledges of rock where formerly dark Indians came to hunt and fish. In summer the water is usually so low that one can walk all about the smooth limestone shelves; but a few days' rain or the melting snow in spring-time will raise the river and turn the lazy stream into a strong, active, and beautiful torrent.

Taking the train once more, we rode for miles close to the left bank of the river, passing soon another rapid fall and its useful saw-mill, after which the river turns and continues its long south-

ern course. For thirty miles little is seen of the river, as its course is so obstructed by many rapids and boulders that navigation is impossible. Then near the end of this course a mighty tributary, the Mohawk, comes up from the west, bringing enough water to double the volume and prepare for the great business part of the river. One-half of its length has now been described. The last half is well called the lower course.

The Lower Course, or the Navigable Section, begins at Troy, a wide-awake business city on the eastern bank, where its situation on the elevated alluvial bank or side-hill attracts admiring attention from the other side of the river.

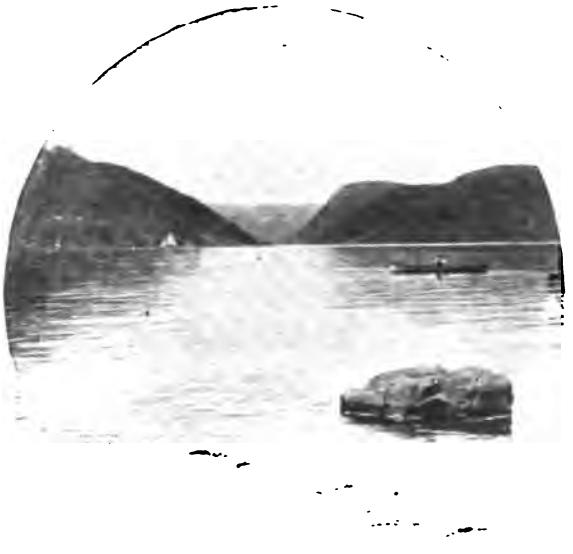
At Albany, a few miles below, we exchanged our train for the day trip down the great river in an elegant steamer. Albany is a large and prosperous city of 100,000 people, and is built on the western side of the river, where the banks are abrupt. It has some very steep streets. The State Capitol is the most conspicuous building, as it stands on high ground and can be seen for miles. This city has grown rapidly since the Erie canal was finished. Six railroads center here and several cross the river by a fine iron bridge. We secured a seat in the bow of the boat, so we could see both sides of the river at once, and we enjoyed a never-ending series of pictures for a distance of 150 miles, The banks of the river below Albany are well wooded and appear much as nature has left them. The scene is, at first, not inter-



esting. Now and then we pass some promontory where sheep or cattle are grazing or some little village appears among the trees.

When about thirty miles had been traversed, we began to notice elevations of some size. On the right we caught glimpses of mountains; but in most places they were concealed from view by the banks of the river or the foot-hills. It was not until we had left Catskill landing ten miles behind that we obtained our best and most satisfactory views of this well known section. On the eastern side, an island is occupied by a large residence. Just before reaching this island, we passed the large, deep bay in which Fulton built the "Clermont," the first practical steamboat in the world. The Livingstones aided him. They owned a large estate here named "Clermont." As we glided down the stream, fine residences were more and more frequently seen. Summer homes took the place of castles on the Rhine, and cliffs, points and promontories were more frequently seen than islands in the lower course.

The constantly changing width of the river adds very much to the variety of its beauty. About half way to New York the river is wider than usual and here we passed under a fine iron bridge for railroad traffic. Then the river became narrower and the banks much higher. Again the river widened to one and a half miles, and we soon passed on the right. Newburg, built on the steep sides of the bank. The fashionable street is three hundred feet above our steamer and commands a fine view of the Northern Gate to the entrancing Highland section. We now enter historical ground. The house occupied as headquarters by General Washington



ENTRANCE TO HIGHLANDS, PEEKSKILL BAY.

when at Newburg, can be seen by visitors, if they take the trouble of climbing to the higher portion of the city.

On the left, we passed Idlewild, a bit of charming country, rich in hills and dales, where the poet Willis lived. Then we went thru the gate, that is, between Mt. Breakneck on the east, and the bold, stern peak called by Willis, "Storm King," on the west. The latter is fifteen hundred feet high, and is clothed with trees to its summit. As the river tears its way thru these great barriers, it becomes about half its previous width, and its current, more powerful. Numerous high peaks are seen on either side. Cro' Nest signals to the opposite peak, and both look down upon

STORM KING MOUNTAIN—HUDSON RIVER.

West Point at their feet. Few places have more really beautiful surroundings than West Point. The view (page 104) from the site of old Fort Putnam above the military academy out towards Newburg, can rarely be matched for variety and loveliness in any part of the world. On the opposite side of the river is a large island where the author of "The Wide, Wide World" formerly lived. Above this island lies a little village called Cold Spring, in which Major Parrott made his famous cannon for the Civil War.

After leaving West Point we passed Buttermilk Falls, said to be very beautiful when there is plenty of water. From a point on the opposite side, General Arnold, the traitor, escaped to the British vessel, Vulture, when his treason became known. For seventeen miles we sailed by over-hanging peaks, thru enclosed bodies of water, which seemed like mountain-girded lakes. In one place the river forms a beautiful crescent in order to pass around a lofty peak known as Anthony's Nose, altho you can see no resemblance to a human nose. Two Revolutionary forts were built opposite this peak, because the river is very narrow here and the position was favorable for preventing the enemy from coming up

ANTHONY'S NOSE. COPYRIGHT, S. R. STODDARD.

the river. This part of the river is sometimes called the "Horse Race," because the current is so swift. After passing the Dunderberg mountains, the river turned toward the west, the steamer glided thru the southern gateway to the lovely Highlands, and we sailed into Haverstraw bay, where the river becomes nearly three miles wide. This bay is separated from the next bay by a long, sharp point of land on the left. This point forms the mouth of Croton river from which New York derives its pure water supply. This water is carried in a large aqueduct forty miles before it reaches the thirsty ones in the great city.

HUDSON RIVER FROM HILLS BACK OF SING SING.

Soon we were in the largest of all the bays, the "Tappan Zee," and we quickly approached the white walls of the prisoners' palace, the well-known "Sing Sing," the New York state prison.

"SUNNYSIDE." HOME OF WASHINGTON IRVING.

This name in the Indian language means 'stone upon stone.' The farther south we proceeded the more numerous became the sailing craft on the river. We met and passed canal boats in bunches, hurried on by powerful, noisy tugs, schooners, steamers and every variety of yacht, from the tiny boat for four up to the million-dollar steam yacht of the rich man.

In this same bay we hurried past Sleepy Hollow, Tarrytown, Sunnyside, and Irvington, all connected in some way with America's great writer, Washington Irving. More and more we realized that the eastern shore is only an elongated suburb of New York. Soon arose on the west the frowning wall of trap rock, known as the Palisades, rising two to five hundred feet above the steamer. Seen from the distance, it looked like a real wall gradually decreasing in height as it approached the south; but, as we came nearer, we observed that it was somewhat broken up by valleys and small peaks. The Palisades are almost entirely in the state of New Jersey.

If you happen to notice where the railroad crosses the water on the left, you will see the mouth of the stream, which marks the northern boundary of New York city. A little below is the site of Fort Washington, and nearly opposite, close to the edge of the cliff, is a hotel occupying the spot where Fort Lee once stood. Here the

Palisades are supposed to end.

The increase in the river travel showed that we were coming nearer to the end of our journey. Soon a part of the great metropolis, Washington Heights, covered with its fine residences, appeared on the left. Then came the Riverside Park, where we passed the stately monument to General Grant. In a few minutes more we steamed along between lower New York and Jersey City. This part of the Hudson is sometimes called the North river. As we neared our pier we saw the Statue of Liberty in the distance, and the great harbor full of nautical life. The harbor is formed by the union of the East and North rivers, and, altho the Atlantic ocean is several miles away thru the Narrows, or entrance from the Lower Bay, the mouth of the Hudson may be considered as being in New York bay. Before landing we saw coming and going, foreign steamers, most of them modern floating palaces, ships from all parts of the world, hundreds of tugs, ferry boats, long propellers carrying trains of freight cars, yachts and every variety of craft.

A PINNACLE OF THE PALISADES.

We had descended our river from the wild woods, the quiet lakes, the sparkling brooks, the green banks and the quiet summer homes, to the mouth of the great commercial river and to one of the busiest seaports in the world, Greater New York, the second city in size and importance on the globe.

THE STUDY OF PHYSICAL GEOGRAPHY UPON THE PACIFIC COAST

BY H. W. FAIRBANKS, GEOGRAPHER, BERKELEY, CAL.

In no portion of the United States are there so favorable opportunities for the study of the origin and development of geographic features as upon the Pacific Coast. The complicated geological history of the region in recent times has given rise to an exceedingly varied series of land forms. This region is far from being a unit in its physical development. It is broken up into many distinct provinces each of which has had a different history, each of which has peculiarities of physical features, of climate and of productions.

Our schools have as yet made but little use of this wealth of material. Our school books take their illustrations from all over the earth, but make only slight reference to home conditions. The great trouble has been that until recently no one has attempted to describe our home geography in such a way that the schools can make use of it. A vast amount of geological work has been done upon the Pacific Coast, but it has been mostly buried in technical papers which only specialists could read with profit. We have reached a point where we understand fairly well the meaning of the important physiographic features, and now our knowledge must be adapted to the use of teachers and pupils.

In the study of our physical features many strikingly interesting facts are encountered. Perhaps the most important of these is the great variety of geographic features, climates and productions intimately associated. The main mountain ranges run parallel with the coast line; but as the storms and prevailing winds are from the west, one has to go but a short distance inland from the fairly uniform climatic conditions of the immediate coast to encounter those where the daily range of temperature is great and the summer and winter climates are very different. One has to travel but a short distance in some parts of California to

observe mountain ranges exhibiting various stages of growth and decay, from recently elevated mountain blocks with dashing streams and rugged scenery, to those reduced to an undulating plain where the forces of erosion are at a minimum.

Upon the westward side of the mountain ranges the precipitation is abundant, upon the eastern it is less, and the latter slope is often a desert waste. Mountain tops, where the snow never melts, and where glaciers formerly existed, contrast with fertile valleys at their base, where sub-tropical fruits are the main dependence of the inhabitants. It is the great variety of facts which can be brought home to students thru personal observation which should make physical geography in the Pacific Coast region of such fascinating interest.

Nearly every phase of mountain building and decay are to be observed here. Volcanic features, many of them so recent that they have not yet been modified by erosion; coastal forms characteristic of recent elevation and also of submergence; and phenomena of the glacial period, everywhere observable in the high Sierras; all these present themselves for study.

In the following lines I shall give a brief description of the more important features of the Pacific region and some elements of their history. Our great mountain ranges are of recent origin. In fact, some of them are still growing, as is shown by the fresh earthquake scarps along their bases. They are faulted blocks of the earth's crust and are best typified by the great Sierra Nevada mountains. This range dominates in the geography of California. It has a gentle western slope but an exceedingly rugged and picturesque eastern face, where for over one hundred miles there are granite walls rising from 8,000 to 10,000 feet from the desert valleys at their base. Long ago this mountain wall did not exist, and the range formed a part of a more or less elevated and undulating region, stretching as far east as the Wasatch mountains. Later in its history, when the range had been detached from others in the Great Basin region, thru the formation of faults, the western slope was worn down almost to baselevel. Broad valleys filled with rock waste marked this slope, the climate was warm and the vegetation and animals differed from those of the present.

Finally an uplift affected the region, the mountain block was tilted to the west, and erosion went to work with renewed energy. As a result of this uplift we have the deep and picturesque

canons of the present day. Among these canons the Yosemite valley deserves to be mentioned for its grandeur. The undulating surface of long ago is still well preserved in the flat-topped peaks and ridges, as well as in the auriferous river channels on the divides between the present streams. During the glacial period the canons were widened and deepened, giving rise on the retreat of the ice to hundreds of beautiful lakes. In the grinding and polishing of the granite, the formation of cirque valleys, lake basins and moraines, there are excellent opportunities for the study of glacial forms.

Turning from the Sierra Nevadas, now in their rugged maturity, we find toward the south an extensive arid region known as the Mojave desert. This stretch of country has not been broken into fault blocks, and presents in its topographic features the most marked contrast to the Sierra Nevadas. The desert is an inclosed basin with an originally rugged mountain surface. Thru a prolonged cycle the valleys have been deeply filled with the waste from the mountains, until at the present time the mountains themselves have nearly disappeared beneath the long debris fans or waste slopes which have gradually encroached upon them. During the glacial period the valleys were occupied by shallow lakes, whose beds, now dry, are either barren stretches of clay or whitened with borax and soda deposits.

Passing the desert and continuing still further south we cross the San Bernardino range, and find that it has a rugged southern scarp facing away from the desert. It is similar to the eastern face of the Sierra Nevadas, but older and more deeply dissected. The Santa Ana mountains in southern California also constitute a fault block with an abrupt eastern scarp. At the foot of this scarp lies lake Elsinore, occupying the lowest portion of the depressed block. Mountain making movements are still at work in the San Jacinto range. The recent earthquake in that region was most violent along a mountain scarp of late origin.

We have been looking at mountains formed by faulting. In the Coast Ranges the parallel northwest and southeast ridges have been brought out thru folding, faulting and subsequent erosion along lines of structural weakness. Erosion perhaps has here done the most towards bringing out the often picturesque features of this region. The rugged scenery of the Klamath mountains in northwestern California is probably entirely due to the deep dis-

section of an elevated mountain region thru the action of running streams.

Volcanic forces have played an important part in the formation of the physical features of the Pacific Coast. One of the greatest lava floods known in geological history spread over portions of Oregon, Idaho, Washington and California, entirely burying the earlier topography. Toward the close of the Tertiary period the great volcanoes such as Shasta, Rainier, Hood, besides hundreds of smaller ones, were slowly built up. Mount Shasta, the highest of these, has been extinct so long that its sides are now deeply scarred. Many of the later cones are still intact, and almost as perfect as when the eruptions ceased. The little cones are generally formed entirely of fragmental material, and have a steep slope and symmetrical outline. The Mono craters in eastern California possess some of the most interesting features of their kind to be found in the United States. They were built up from viscid flows of an acid lava and of volcanic ashes, and are almost as perfect today as when the lava cooled. In the volcanic regions earthquake scarps from ten to several hundred feet in height are very frequent, and upon the northern side of Mono Lake are deep open fissures.

The plains and broader valleys of the region under discussion might be considered under three heads: volcanic plains, lake plains, and sea plains. The great stretches of almost level lava beds are characteristic of the Columbia plateau region. They have been deeply canoned by the larger streams and broken up into mountain blocks thru faulting. Lakes formerly occupied many of the gentle depressions in the lava plains, and are to be found in some of them at the present time. The desert plains between the mountain ranges of western and northwestern Nevada were once occupied by the glacial lake Lahonton. For miles these plains are as level as a floor and utterly barren.

The valleys of the Great Basin are of structural origin, occupying the areas of crustal subsidence between the mountains. They have no outlets and for thousands of years have received the wash from the surrounding mountains. Some have been occupied by lakes, others have been too arid and are formed entirely of the long, gentle wash slopes so characteristic of the arid portions of the west.

The Great Valley of California, embracing the San Joaquin

and Sacramento valleys, forms the largest area of valley land upon the Pacific slope. The valley was originally structural in its origin, which dates far back in geological time. For ages it has received the wash of the streams from the Sierra Nevadas and a part of the time from the Coast Ranges. It has formed an arm of the sea, and at times much of it has been occupied by a fresh-water lake. At the present time the tide reaches into it, and large areas in the lower portion are flooded during extremely wet seasons.

The long waste slopes at the foot of the mountains already referred to are very characteristic of the topography of southern California. They are gently inclined plains, often many miles in extent, which have been built up in earlier eroded valleys. The waters from the occasional heavy storms dash down the mountain gorges, sweeping all the loose rock before them. After leaving the canon mouth the waters are no longer confined, and spreading out over the valley slope, drop their burden of gravel and boulders, and so slowly form the extensive waste slopes. Where water can be carried, these slopes have proved to be very fertile.

The lakes of the Pacific Coast region are mainly of two kinds, glacial lakes and lakes occupying inclosed basins. The former are confined to the Sierra Nevadas while the latter characterize the valleys of the Great Basin. There are a few lakes formed by the damming of river valleys at the last subsidence of the coast.

There is another type represented by Crater Lake, Oregon. This is perhaps the most wonderful lake of its kind in the world, and will unquestionably in time become as renowned as the Yellowstone and the Yosemite. It occupies the crater of an extinct volcano. It is situated upon the very summit of the Cascade range and inclosed by walls from 1,000 to 2,000 feet high, the water itself being nearly 2,000 feet deep.

The complicated history of the Coast Ranges is recorded in the complex topography. Repeated elevations and depressions have marked the history of this region. In quite recent times it has been submerged to a depth of 800 to 1,500 feet. Previously it was elevated probably from 1,000 to 2,000 feet above the present level. The last event has been a subsidence drowning the mouths of nearly all the streams. The broad valleys over which the streams meander before entering the ocean, are not then the result of the

gradual widening of the flood plains of streams in an advanced stage of their development; they are the alluvium filled valleys eroded out during the past period of elevation, and lately graded up and adjusted to the present conditions.

Coastal plains of varying width border much of the coast of California where the mountains are not too abrupt. They are of two kinds. One is found typically developed in the level country between Los Angeles and the ocean. This is an elevated plain of marine deposition. Into its exposed edges the waves are now eating. The one which stretches so continuously along the coast is a plain of erosion, and was cut by the waves upon the upturned edges of the underlying rocks. Above this plain, which often has a width of a mile or more, are narrower, terrace-like benches, also cut by the waves.

The direction of the mountain ranges together with the present elevation of the land have left California with few deep bays. San Francisco bay occupies the drowned mouth of a great river system, whose tributary streams have given rise to the different arms which reach out in various directions.

California is bordered by a submerged continental plateau. This is many miles wide in places, particularly off the coast of southern California. The large coast islands represent the peaks of submerged mountain ranges. Narrow valleys extend across this plateau from the deep waters of the Pacific close up to the present shore line. We can account for these valleys most easily by the supposition that they were formed by erosion during the last great uplift of the coast.

There are very wide-spread remnants of a partial baselevel in the Coast Ranges. One of the most prominent of the higher terraces is that found from 750 to 900 feet along different portions of the coast. The waters of the ocean stood at this level for a long time—time sufficient for the extension of a great baseleveled plain from the ocean and up the valleys of the larger streams. The valley of the Salinas river is characterized in particular by a nearly level plain reaching a length of one hundred miles. North of the bay of San Francisco, along the coastal regions of northwestern California, there is another extensive plain of probably the same age. Upon the summits of many of the higher ranges of western California, as far south as the Mexican line, there are remnants of a still older plain of erosion.

What has been given is sufficient to show the great variety of topographic features in the region described. We could hardly ask for more interesting surroundings for the practical study of the earth's features and the influence which these exert upon the climate, productions, and the spread of civilization.

A LESSON PLAN FOR THE STUDY OF A NATURAL PRODUCT

BY CLARA L. POE, STATE NORMAL SCHOOL, WINONA, MINN.

The following plan was made for a lesson given in the seventh grade, before a class of student teachers. It illustrates the Herbartian method, and was designed to show the five formal steps of instruction, in their practical application.

AIM.—To teach "Petroleum" as an important mineral product of the United States.

PREPARATION.—Review briefly a few of the natural products of the United States, already studied.

I. Vegetable products.

II. Mineral products.

PRESENTATION.

I. Material.

1. Literature.

a.) Rocheleau's "American Industries."

b.) Carpenter's "Geographical Reader."

c.) "A Lampful of Oil." Illustrated. *Harper's Magazine*, Vol. 72, p. 235.

d.) "The Petroleum Region of America." Illustrated. *Harper's Magazine*, Vol. 30, p. 562.

e.) "Striking Oil." Illustrated. *Century*, Vol. 4, p. 324.

2. Illustrative material.

a.) Objects.

1.) Paraffin.
2.) Kerosene.
3.) Paraffin oil.
4.) Vaseline.
5.) Gasoline.
6.) Aniline.

b.) Map of United States.
c.) Diagram of oil well.
d.) Pictures.

II. Method.—Recitation by topics, supplemented by questions, and illustrated by the above material.

TOPICAL OUTLINE

I. Discovery of petroleum in the United States.
  1. By the Indians.
    a.) When and where?
    b.) Manner of collecting. Use.
  2. By Colonel Drake.
    a.) When and where?
    b.) Manner of procuring.
    c.) Yield. Results.

II. Formation of petroleum.
  1. Different theories.
    a.) Animal vs. mineral origin.
  2. Collection of oil in the pool.
    a.) Conditions necessary.
    b.) Contents of oil-pools.

III. Boring wells.
  1. Use of the drill.
  2. The sand pump.
  3. Kinds of wells.
    a.) Blowing wells.
    b.) Wells flowing oil.
    c.) Wells flowing water.
    d.) Use of dynamite to renew the flow.

IV. Transportation of oil.
  1. Railway tanks.
  2. Pipes.

V. Refining the crude oil.
  1. Distillation.
    a.) Describe process.
  2. Products.
    a.) Solvents: highly volatile oils.
    b.) Illuminating oils.
    c.) Lubricating oils.
    d.) Solid paraffin.

VI. Uses of petroleum.
1. As medicine.
a.) By the Indians.
b.) In surgery, (rhigolene.)
c.) As an ointment, (vaseline.)
2. For lighting.
a.) Kerosene.
b.) Gasoline.
c.) Gas made from gasoline.
d.) Gas made from crude oil.
3. For heating.
a.) Petroleum—in engines.
b.) Gasoline—in stoves.
c.) Naphtha—in engines.
4. For lubricating.
a.) Machine oils.
5. For making varnishes.
a.) Naphtha.
6. Dyes.
a.) Aniline.
7. Candles. Chewing gum.
a.) Paraffin.

COMPARISON.—Compare petroleum with other mineral products already studied, as to
I. Number of products.
II. Importance.
III. Commercial distribution.

GENERALIZATION.—Petroleum is one of the most important and most widely distributed mineral products of the United States. Crude petroleum yields about two hundred different products.

APPLICATION.
I. On an outline map of the United States locate the three most important petroleum districts.
II. Have written composition on "Petroleum," using the material taken up in this lesson.

ILLUSTRATIVE LESSON UPON LATITUDE AND LONGITUDE FOR FOURTH GRADE OR ABOVE

BY THEDA GILDEMEISTER, STATE NORMAL SCHOOL, WINONA, MINN.

NOTE.—The following plan is intended to show the relation of the "formal steps," and is thus called one lesson, but it may cover from five to ten recitation periods, according to the ability of the class. The special treatment is for beginning fourth grade pupils, but the same general plan has been successfully used in higher grades.

AIM, divided into the sub-aims of the successive recitations:

1. To teach the necessity for parallels and meridians.
2. To teach location and name of parallels.
3. To teach location and name of meridians.
4. To teach the practical use of parallels in locating places upon the earth's surface.
5. To teach the practical use of both sets of lines.

PREPARATION: Questions, leading children to see the different methods of locating places.

1. In school building. (Normal.)
2. In country.
3. In city. (Winona.)
   a.) By well known buildings. Postoffice, opera house, hospital, library, various school buildings, etc.
   b.) By street and number.

For example: 1. (Numbers in "method" will, thruout the article, correspond with numbers in outline.) Elmer, could you take this picture to Miss Speckman for me? Tell me where you will go, that I may be sure you know the room. (If Elmer doesn't know, let some child tell him.)

Ask other questions about the location of various rooms—the music room, the museum, the physical laboratory, the library, etc.—letting children see that we must have knowledge of some rooms, as "guide posts" to us in finding others.

2. In the country, we tell strangers where to find desired houses, roads, etc., by the hills, mountains, bluffs, valleys, rivers, bridges, cross-roads, or by houses passed. Or we may speak of the number of miles. Bring this out by questions. If the school is in the country, children may be asked to tell how to reach their homes, etc.

3. *a.*) In a city, when asked by a stranger to locate some place, we usually ask him whether he knows where the postoffice, hotel, library, or normal is, or we show him one of these buildings as his "guide post." Ask children to locate (in Winona) Elmer's art store, their own homes, etc., and their answers will prove the above statement true.

b.) Is there any better or surer way of locating places? (By knowing the street and number of the house.) How could a stranger find the street and house? (He would need a map giving names of the city streets, etc. Children have made city maps, and hence understand this.)

PRESENTATION: 1. Places on earth's surface, how located?

a.) By mountains, rivers, lakes, etc. (Buffalo is at the eastern end of Lake Erie. New Orleans is near the mouth of the Mississippi river, etc.)

b.) By what corresponds in a city to the street and the number of a house.

(1.) Use a globe or map, on which we can see these "streets." Study the globe and some maps, and learn:

(*a.*) Location of lines.

(*b.*) Names of lines.

(*c.*) Numbers of lines.

Discussion of *a.*) under 1. may be followed by reference to sailors upon the ocean, with no mountains or other forms to guide them, leading children to see the necessity for more accurate means of location. Outlined under *b.*)

(*a.*) Therefore men have drawn lines upon the globe (explain carefully that these lines are only imaginary upon the earth itself) and upon maps which represent the earth These lines cross one another and look much like our streets, when shown on a map. Children examine the globe and some maps. (Use globe as much as possible.) Draw your fingers over some of the lines

which you can see. Which lines run north and south? Which run east and west?

(*b.*) What do you notice about the east and west lines? Frank, Hattie, and Walter may put their fingers here. Each may follow his line, going east. Others may watch the fingers. Were they the same distance apart all of the time? Rosse, put on the board some lines that are the same distance apart thruout. What are such lines called? (Parallel lines.) Are the east and west lines on the globe parallel lines? (Yes.) And, because they are parallel, they are called a name which shows that. Teacher writes *parallels* on the board and children learn to spell the name, and to trace the parallels again and again.

Later, when ready for the study of meridians, the teacher may ask: Are the north and south lines parallel? (Trace, as was done with the parallels.) Were the fingers the same distance apart all of the way? (No. They all came together, at each pole.) These north and south lines are called *meridians*, but you could not now understand the reason for the name. (Teach spelling and pronunciation, and let children trace meridians. Then try both parallels and meridians to see that there is no confusion of names.)

(*c.*) Just as each street in Winona is named or numbered, so each parallel and meridian has a number. Starting at the equator (children have learned about the equator and know reason for its name), the men who first planned these lines, made 89 parallels between the equator and the northpole, and 89 parallels[1] between the equator and the south pole. (Let children point to north pole, south pole, equator, and then tell how many parallels in each half.)

As all cannot easily see the globe, I will draw a map on this board and we can continue our study upon that. (Teacher draws large circle with arm for the radius, locates equator with colored crayon, and numbers it 0,—the starting point.) We have a street in Winona (Center street) from which the houses are numbered both ways. Just as we have 225 *east* Fifth street, and 225 *west* Fifth street, so we have a fortieth parallel *north* of the equator, and a fortieth parallel *south* of the equator, as the parallels are numbered from the equator both north and south.

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[1] Parallels here understood to be one degree apart. Term "degree" not yet familiar to children.

My map is too small for me to put in *all* of the parallels, so I shall put in only eight, letting you imagine the absent ones. (Teacher talks as she draws, explaining how to divide each quadrant into thirds, and then each third into thirds; how to connect the opposite points of division, making eight parallels; how nine parallels have been omitted between each two drawn, and hence the first shown must be numbered 10. Then derive from children the numbers for the other parallels, and for the point marking the pole. In the same way, put the parallels into the southern half of

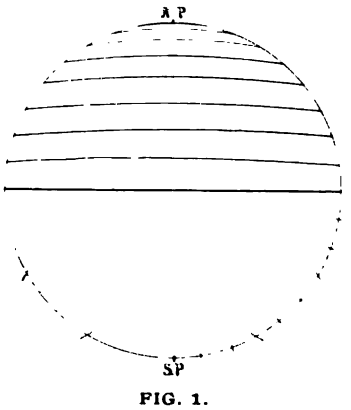

FIG. 1.

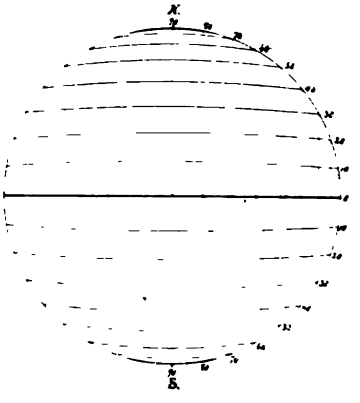

FIG. 2

the map. Figures 1 and 2. It seems advisable to apply this work upon parallels, *before* giving that upon meridians—see "Application, *a*.")

After "application *a*," and the introduction of "meridians" as suggested under (*b*.), the teacher may ask: Would there be any difficulty in finding your house if I knew only the street? What else must I know? (The number, or, if on a corner, both the streets.) The same thing is true on our globe. If I tell you that I live on the tenth parallel, you would be obliged to walk many miles searching for me. But if you know the second "street" (meridian) on which I live, you could easily find me.

Let us now draw some of the meridians on our map. As with the parallels, we haven't room for *all*, so I shall omit nine between each two, as we did with the parallels. (Teacher explains as she works, dividing equator into halves, each half into thirds, and each one-third of the one-half into thirds again. Drawing the lines

from pole to pole thru the points of intersection will give the seventeen meridians *within* the circumference, the halves of which now make the two outer meridians.)

As the equator divided the south parallels from the north, so we must have one meridian which will divide the east meridians from the west meridians. Long ago one such was chosen and called the *prime meridian.* I will help you about the meaning of *prime.* What is a *primer?* (Teacher writes word on blackboard.) Yes, your *first* reading book. What is the *primary* room at school? What do I mean when I say these are *prime* oranges? (*First* class oranges.) (Older children may know of political meetings called *primaries,* of England's *Prime* Minister, and possibly of *prime factors.*) Let us now look at these words I have upon the board. What likeness can you see? And what general meaning do we find in all? The *prime meridian* must mean ——? (The *first* meridian, or the starting point.)

I will mark (with crayon) the prime meridian on our globe and then I want you to watch the globe while I turn it. Where do you now see it? (At the right.) Now? (We can't see it at

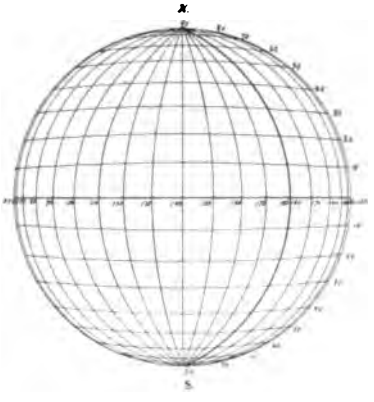

FIG. 3.

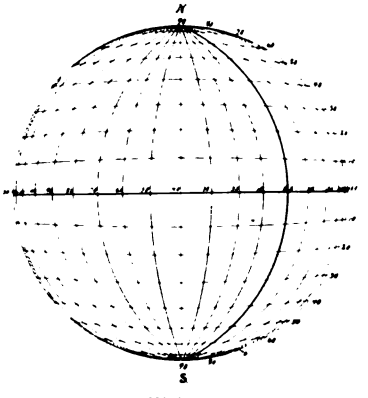

FIG. 4.

all.) (Later it will be seen appearing at the left,—approaching the front,—again at the right, etc.) I should like to make the prime meridian on our map with colored crayon, as we did the equator. Which meridian shall I call prime? Could it be *any* one on my map? Why? Let us locate the prime meridian on our map, as the one on the globe looks to Walter. Walter may show

us. (In succeeding lessons change the location of the prime meridian on the map, so that children will learn that it is not relatively *fixed*, as is the equator.)

What number did we give to the equator when we talked about latitude? We shall give our prime meridian the same number. All of the meridians at the right of the prime meridian are said to be *east*, and all at the left, *west*. [Lead children to number the meridians, and to see that only half the globe can be seen at once, so that we must make *two* maps to show the entire surface. (Figures 3 and 4.) The outer edges coincide, so are numbered the same.]

ASSOCIATION AND COMPARISON: By reviewing, bring out the differences and similarities found in

1. Parallels and meridians.
   - *a.*) Direction of, on globe.
     Parallels are drawn east and west.
     Meridians are drawn north and south.
   - *b.*) Relative position.
     Parallels are parallel.
     Meridians meet at poles.
   - *c.*) How numbered.
2. Methods of locating places.
   - *a.*) Compare locating places in the country with locating places on the earth's surface by means of "landmarks."
   - *b.*) Compare locating city houses by street and number with locating places on earth's surface by means of parallels and meridians.

GENERALIZATION: Children should conclude that parallels and meridians are necessary for accurate location of places on the globe; should know how they are drawn; and should know how to use them. If old enough to understand it, children could learn about the dropping or adding of a day at the 180th meridian.

APPLICATION: *a.*) (To follow first half of presentation—upon parallels.) Now, let us see how we can use these "streets" that we have called parallels. Let us play "hide and seek." Each of us may select a "street" upon which to live, and the others may try to find that street. I have found mine. I live on parallel 40, north. Find. (Children tell, one by one, where they live, and

others find. Many given by teacher, varying the form of question, and using term *latitude* frequently, as—'a friend of mine lives on the thirtieth parallel, south latitude. Find.')

OTHER DEVICES

The teacher may vary the succeeding recitations by using some of the following:

(1.) Teacher makes x's on various parallels and children describe the location, seeing how few errors are made.

(2.) Teacher writes children's initials at certain places and children tell locations.

(3.) The teacher may write the descriptions of various locations, and let children locate them on the teacher's map, or on individual ones made by the children for seat work. Teacher may give several forms of expression, as: (*a.*) Forty degrees north of the equator. (*b.*) Forty degrees north latitude. (*c.*) 40 degrees north latitude. (*d.*) The fortieth parallel north of the equator. (*e.*) 40° north latitude. (*f.*) 40° N. Lat. Children locate by x's, or the descriptions may be numbered and children use corresponding number on map. The use of the word (and sign for) *degrees* may be taught by showing children that instead of saying: "We live on the fifth street from here," we say: "We live five blocks from here." So I may say, "I live ten *blocks* north of the equator," rather than, "I live on the tenth parallel north of the equator." But these *blocks* are not like our city blocks, for each is nearly seventy miles long, and is called a *degree*. Show me the "Brown Baby's" home, which is thirty degrees south latitude, etc.

(4.) If children have read "Seven Little Sisters," the home of each "sister" may be located.

(5.) Follow these lessons by some which will show locations of places *between* the *drawn* parallels. First use 45, 35, 15, 5, etc. Later take 29, 71, 63, etc.; until children freely locate any place upon the right parallel.

b.) After *meridians* have been taught, almost the same devices as were given under *a.*) can be used, save that instead of drawing the pointer along an entire line to show a person's home, only one spot can be pointed out. Begin with "even" locations, as 70° north and 20° east. Later introduce the intermediate steps, as 55° south and 20° west; then 35° north and 75° west; then 61° north and 37° east; etc. Use term *longitude* as teacher did *lati-*

tude, so frequently that children learn its meaning by association. When children are fairly familiar with use of map, give such locations as 90° north, 25° east, and 0° south, etc.

Each child could, at his seat, draw a map and correctly number the lines. Then the teacher could place upon the board ten statements of locations, using both latitude and longitude. Children will place corresponding letters or figures at proper points on the map. Children may do this as seat work, or as a contest of speed, in class.

Another plan would be to give children the names of from ten to twenty well known cities, mountains, etc., and let them find the latitude and longitude of each. Later these could be marked upon the children's own maps.

THE PHYSIOGRAPHIC FEATURES OF MARYLAND*

BY CLEVELAND ABBE, JR., WINTHROP NORMAL AND INDUSTRIAL COLLEGE, ROCK HILL, S. C.

The State of Maryland extends from, approximately, the 75th meridian to west longitude 79° 30′. It thus embraces within its boundaries portions of the Atlantic Coastal Plain, the Piedmont Plateau, and the Appalachian Ranges and Plateau, the three geologic and geographic provinces of the Atlantic slope of North America. The state may, therefore, be said to present in its own varied topography, an epitome of the surface features of the whole Atlantic slope.

Of these three provinces, the Piedmont plateau is the oldest. This is shown both by comparing its highly metamorphosed crystalline and sedimentary rocks with the relatively unaltered strata of the other provinces, and by the character of its topography. From the Piedmont, in early geologic time, were obtained the materials which are now found built into the folded and faulted strata of the Appalachian regions. From both Piedmont and Appalachian districts a great volume of sand, gravel,

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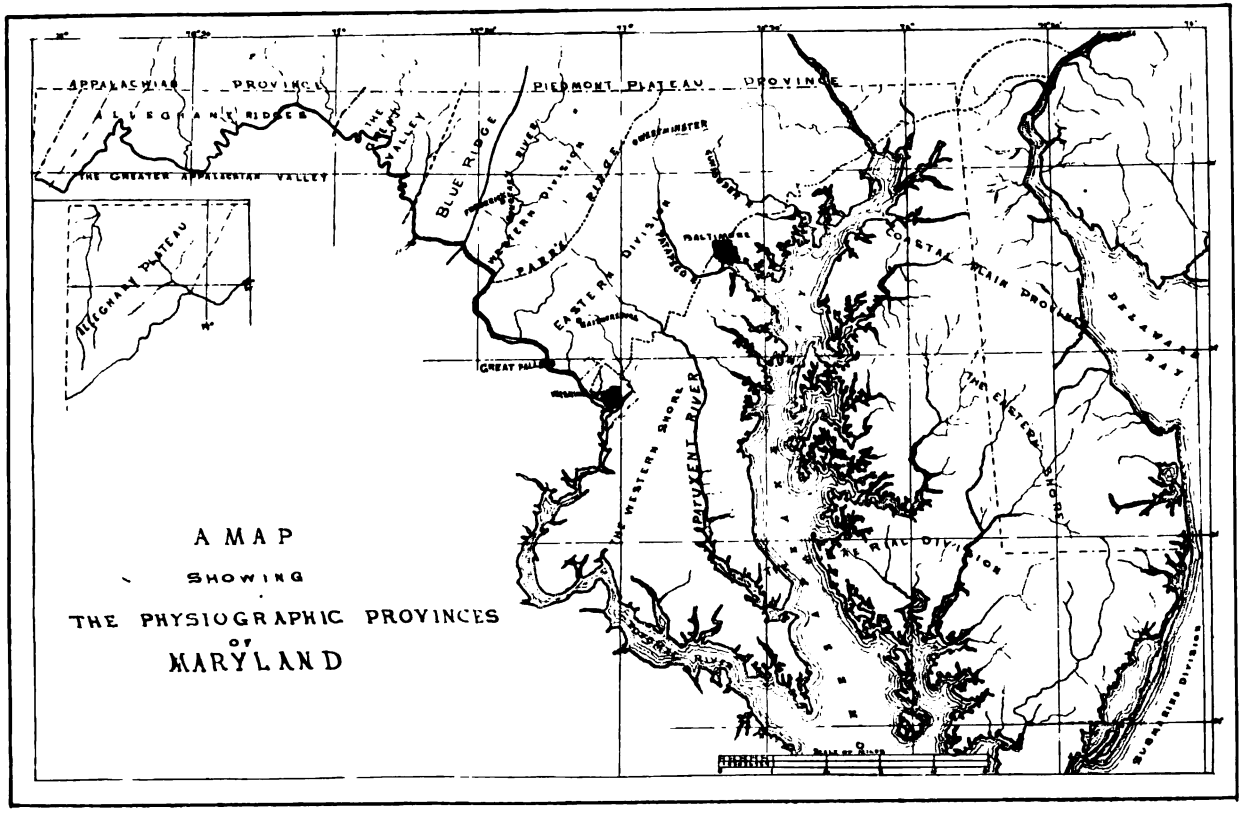

APPALACHIAN PROVINCE
ALLEGHANY RIDGES
THE GREATER APPALACHIAN VALLEY
PIEDMONT PLATEAU PROVINCE
BLUE RIDGE
RIDGE
BALTIMORE
COASTAL PLAIN PROVINCE
DELAWARE BAY
THE WESTERN SHORE
PATUXENT RIVER
THE EASTERN SHORE
A MAP
SHOWING
THE PHYSIOGRAPHIC PROVINCES
OF
MARYLAND

clay and boulders, has been washed during the later periods of geological time. These materials are now found forming the youngest of Maryland's topographic provinces, namely, the Coastal Plain. These three provinces, with their several subdivisions, are shown on the accompanying map. (Fig. 1.) In the following pages the characteristics and the development of the chief surface features of these provinces will be briefly discussed.

THE PIEDMONT PLATEAU

Topography.—The oldest province, the Piedmont plateau, is divided into an eastern and a western portion by the crest-line of the divide between those streams which flow eastward by direct courses into Chesapeake bay and those which flow westward into the Monocacy. This divide is a rather flat-topped ridge which runs in a northeasterly direction across the state from the Potomac to a point beyond Mason and Dixon's line. It has an average elevation of nine hundred feet, rising gradually from its southern end, where it has an elevation of about six hundred feet to a maximum of nearly one thousand feet near the northern boundary of the state.

From this divide, called Parr's Ridge, the general surface of the eastern division of the Piedmont slopes gently southeastward to an elevation of about six hundred feet at its eastern boundary where it seems to pass beneath the western fringe of Coastal Plain sediments. The general appearance of this portion of the Plateau is that of a gently rolling plain traversed from northwest to southeast by a few broad, shallow valleys. Near its eastern limit a few hills and ridges are seen to rise very slightly above the general surface. On looking closer it is seen that the streams have cut trenches or gorges below the general upland surface. These gorges increase in depth as they proceed eastward, and at the same time their channel profiles change from the normal concave-upward type to the less usual convex-upward type. In the excellent view of one of these stream valleys, forming Fig. 2, the foreground illustrates the character of the valley slopes as they lead down to the narrow flood plain over which the stream is now flowing. In the background the crests of the rounded hills neighboring the stream, together with other more distant elevations, are seen to merge into the even and almost level horizon line, which is characteristic of any general landscape view in this district.

Several of the smaller streams of the eastern Piedmont occupy valleys which do not belong, strictly speaking, to the tree-like branching system of most of the streams. These streams are found to be located along bands of soluble limestone whose directions are at variance with the stream-branching usually found here. Deposits of Coastal Plain sediments have been found in these

FIG. 2. THE PATAPSCO VALLEY IN THE PIEDMONT PLATEAU, BALTIMORE CO.*

peculiar, subsequent valleys, whose age is therefore fixed as intermediate between the date of formation of the general upland and that of the earlier Coastal Plain deposits.

Turning to that portion of the Piedmont Plateau situated west of Parr's Ridge, the first character of general importance that catches the eye of the observer is the change in slope of the upland surface. Instead of declining gradually and uniformly, as does the eastern upland, to the line of lowest levels, along the Monocacy, the descent is comparatively rapid for the first portion of the dis-

* Illustrations in this article are furnished thru the courtesy of the Maryland Geological Survey.

tance. The reason for this is clear. In the first place the total change in elevation from the divide to the lowest levels on either side is the same, approximately 500 feet; but on the east this descent is accomplished only after traversing a horizontal distance of over forty miles, while on the west the decline is made within less than half that distance. In the second place, areas of yielding brown sandstones and shales which occupy the central portion of the western division, have further narrowed the horizontal distance within which the decline takes place by extending the low levels found near the Monocacy, for several miles toward the divide.

The streams which flow westward across the more steeply sloping portion of the plateau are characterized, for a short distance from the ridge, by somewhat narrower valleys than are found belonging to the eastward flowing streams. These valleys widen rapidly, however, as they approach and enter the sandstone areas adjacent to the Monocacy. At the same time the general surface of the plateau loses its steeper slope. It becomes almost horizontal for a distance of about eight miles, maintaining an average elevation of 500 feet above sea-level. Then the surface declines rapidly to a lower level of 450 feet where a broad terrace may generally be traced out. Along the present entrenched channel of the Monocacy runs a second and narrower terrace at a level of about 350 feet. Both the terraces and the general upland surface rise gently as they extend northward, and all are now more or less dissected by stream channels cutting across them down to the Monocacy. The channel profiles of all the streams of this district show the normal concave-upward slopes produced by uninterrupted stream growth. The grades, however, are much steeper near the heads of the streams referred to, than they are at corresponding points in the channels of the eastern division streams.

The Rocks and Structure.—The rocks of the Piedmont plateau province include fragmental and igneous rocks, in both metamorphosed and non-metamorphosed conditions. The eastern division is largely composed of altered igneous rocks which have pinched in with them bands of phyllite, slate, quartzite and marble that undoubtedly represent originally stratified rocks. On the west the rocks are largely phyllites, with included marble and limestone lenses, upon which unaltered red sandstones, shales, and

limestone were deposited. These sandstones, etc., are now much faulted.

The dynamical metamorphism which the present crystalline rocks have undergone, has arranged their mineral constituents in long parallel lines and planes which bear no necessary relation to the stratification planes of the originally elastic rocks. From the east and the west the foliation planes dip steeply down towards an axial line. This line, called the axis of foliation, crosses the Potomac near Great Falls, proceeds northward past Gaithersberg and Westminster and on into Pennsylvania. On the western side the strike of the foliation and of the infolded marble lenses is northward, parallel with the axis. On the east after keeping a northeastward course as far north as Westminster, the foliation of the gneiss and its infolded bands of marble, quartzite, etc., makes a sudden turn to the east, follows the new direction for some miles, then again turns northeastward.

Relation of Topography to Structure.—The relation between topographic forms and geologic structure is not a close one in this province. All the larger streams, including the Monocacy except for a short distance, seem to have located their courses quite independently of the arrangement of the bands of yielding and resistant rocks described above. This feature is more strikingly illustrated in the eastern division where the Gunpowder, Patuxent and Patapsco rivers are the best examples. In the western division the Monocacy shows some independence of yielding and of resistant rocks in portions of its course below Frederick, while many of its tributaries from the east are quite indifferent to the foliation and the variations in the phyllites which they cross.

The general indifference to structure shown by the courses of the Piedmont streams, coupled with their peculiarly characteristic tree-like branching patterns have led to the conclusion that the streams did not originate upon the plateau surface as now exposed. Their characters indicate that they developed their present patterns when flowing across an almost smooth and gently sloping surface such as would belong to a series of nearly horizontal marine beds deposited across the beveled edges of the present eroded crystallines of the eastern division. On the west the covering on which such courses could have been developed seems to have been the now partially removed and much faulted red sandstones of the Newark formation. On the east the cover was prob-

ably formed by a westward extension of the deposits of the Coastal Plain.

The streams have cut their channels down thru these coverings and into the formerly buried crystalline rocks, then forming the foundations. The streams were thus able to so fix their courses in the crystallines that subsequent elevation and erosion, resulting in rather widespread removal of portions of the cover, have but served to confirm them the more in their discordant positions. The majority of the present stream courses of the Piedmont are thus seen to be at variance with the existing rock arrangement or structure because they have been inherited from courses developed when those structures were quite hidden beneath a blanket of younger sediments.

(To be continued.)

A LIST OF BOOKS, REPORTS, AND ARTICLES DEALING WITH THE TEACHING OF GEOGRAPHY

BY J. F. CHAMBERLAIN, LOS ANGELES, CAL.

BOOKS

How to Study Geography. F. W. PARKER. Appleton, 1894. $1.25.

This book is invaluable to teachers and advanced students. Much attention given to slopes and drainage basins. Treats of relation between Geography and all other subjects.

Methods and Aids in Geography. CHAS. F. KING. Lee & Shepard, 1894. $1.30.

A very helpful and suggestive work. Directions for the construction of simple apparatus.

The Earth and Man. GUYOT. Scribners. Revised edition. $1.75.

A most able treatment of the subject of Geography, from the human standpoint.

Child and Nature. FRYE. Ginn & Co, 1894. 80 cents.

Of great value to elementary teachers. Deals fully with the psychology and pedagogy of the subject of Geography.

Brooks and Brook Basins. FRYE. Ginn & Co. 58 cents.

How to Teach Primary Geography. FRYE. Ginn & Co., 1896.
This manual is prepared as an aid to teachers using Frye's Primary Geography.

Teachers' Manual of Geography. FRYE. Ginn & Co. 50 cents.
Suggestions to teachers using the Complete Geography.

The Teaching of Geography. A. GEIKIE. Macmillan, 1892. 60 cents.
This book is intended chiefly for the use of teachers of elementary Geography.

Comparative Geography. RITTER. Van Antwerp, Bragg & Co., 1881. $1.00.

Geographic Studies. RITTER. American Book Company. $1.00.
No teacher of Geography should be without these two books. They contain the spirit of the scientific study and teaching of the subject.

Lessons in the New Geography. TROTTER. D. C. Heath, 1895. $1.00.
Treats Geography from the standpoint of man's relation to his environment.

McMurry's Special Method in Geography. Public School Publishing Co. 50 cents.
Advocates the teaching of type-forms. Illustrative lessons on types selected from the Mississippi basin.

Applied Geography. J. SCOTT KELTIE. Philip & Son, London, 1890.
Shows how a knowledge of geography influences human affairs.

Topics in Geography. NICHOLS. D. C. Heath, 1895.
A suggestive course for the grades.

Manual of Geography. GORE. Central School Supply House, 1897.
Directions for the use of maps.

Teachers' Manual of Geography. REDWAY. D. C. Heath, 1892. 46 cents.

The Reproduction of Geographical Forms. REDWAY. D. C. Heath, 1893.

Suggestions on Teaching Geography. McCormick. Public School Publishing Co. 50 cents.
Helpful in class and field work.

How to Teach Geography. Carver. Boston Educational Publishing Co., 1894.

Methods of Teaching Geography. Crocker. Boston School Supply Co. 60 cents.

Oswego Methods in Geography. Farnham. Bardeen. 50 cents.

How to Teach and Study Geography. Wicks and Boyer. E. L. Kellogg. Part I., 50 cents, Part II., 60 cents.

Natural System of Teaching Geography. Beadle. E. L. Kellogg. 40 cents.

Outlines of How to Teach Geography. Parker. Appleton.
A concise statement of the relation of Geography to other subjects.

Dean's Geography Class: How to Interest It. Ida Dean. E. L. Kellogg. 50 cents.

Callahan's Outlines of Geography. E. L. Kellogg. 15 cents.

Realistic Geography. Baker. Blackie, London, 1889. 1s 9d.

Realistic Teaching of Geography. Jolly. Blackie, London, 1887. 1s.

Der Geographische Unterricht nach den Grundsätzen Ritters. Oberlander. L. Gabler, Grimma. M. 3.60.

Die Anschaulichkeit des Geographischen Unterrichts. Trunk.

Beitrage zur Methodik des Geographischen Unterrichts. Delitsch. M. 1.

Der Geographische Unterricht, Besonders auf Höheren Schulen. Richter. M. 1.

Gedanken Über den Geographischen Unterricht. Coordes.

Hilfsbuch für den Unterricht in der Erdkunde. Hummel.

Methodik des Geographischen Unterrichts. Matzat. M. 8.

Leitfaden für den Unterricht in der vergleichenden Erdbeschreibung. Putz.

Grundzüge der Erdbeschreibung mit besonderer Rücksicht auf Natur und Völkerleben. BORMANN.

Methodik des Geographischen Unterrichts. WINKLER.

Geschichte der Methodologie der Erdkunde. LUDDE.

Die Methodik der Erdkunde. LUDDE

Ueber die Geographie als Lehrgegenstand in den Schulen. SCHACHT.

Der Unterricht der Geographie. BORMANN.

Die Methode des Geographischen Unterrichts. BÖTTCHER. M. 2.40.

Die Geographie als Wissenschaft und in der Schule. DROUKE.

Zur Methodik des Geographischen Unterrichts. GELHORN.

Methodik des Geographischen Unterrichts. SCHWARTZ.

Methodische Anssichten über den Stoff und die Behandlungsweise der Geographie. A. V. ROON.

REPORTS AND ARTICLES

The Teaching of Geography in Central Europe. Report of Commissioner of Education, 1892-93. Vol. I.
The educational value of maps is well brought out.

Geography. Report of Geographical Conference. T. C. CHAMBERLIN. American Book Co.

Educational Value of Geography. Report of the Committee of Fifteen.

Report of the Proceedings of the Royal Geographical Society in Reference to the Improvement of Geographical Instruction. Murray, London, 1886.

This contains a report by Keltie on the teaching of geography in the United States, Canada and Europe; a chapter by Ravenstein on methods; one by Bryce on the relation between geography and history; and a discussion of some of the scientific phases of geography by Moseley.

The Study of Geography. D. C. GILMAN. Atlantic Monthly, Vol. 67.

Modern Scientific Geography. DR. KLEIN. Popular Science Monthly, Vol. 9.

Geikie on the Teaching of Geography. FERNALD. Popular Science Monthly, Vol. 32.

Geography. A. D. WHITE. Popular Science Monthly, Vol. 41.

The New Geography. A. P. BRIGHAM. Popular Science Monthly, Vol. 48.

The Present Standpoint of Geography. MARKHAM. Smithsonian Reports, 1893.

The Function and Field of Geography. KELTIE. Smithsonian Reports, 1897.

Teaching of Geography. W. M. DAVIS. Educational Review, Vols. III and IV.

Geographic Instruction in Germany. W. S. MONROE. Journal of School Geography, Vol. I.

Concrete Geography. CHAS. F. KING. Bulletin of the American Bureau of Geography, Vol. I.

History of Methods in Instruction in Geography. J. R. POTTER. Pedagogical Seminary, Vol. I.

Status of Geography Teaching. J. W. REDWAY. Educational Review, Vol. VII.

Geography as a Basis for Correlation. J. F. CHAMBERLAIN. Bulletin of the American Bureau of Geography, Vol. I.

Educational Value of Geography Study. E. I. MILLER. Bulletin of the American Bureau of Geography, Vol. I.

Need of Geography in the University. W. M. DAVIS. Educational Review, Vol. X.

Geographic Interests of Children. EFFIE MAY WARD. Education, Vol. XVIII.

What to Teach in Geography. H. MCCORMICK. Bulletin of the American Bureau of Geography, Vol. I.

The Rational Element in Geography. W. M. DAVIS. National Geographic Magazine, Vol. X.

Geography Study for Teachers. Journal of School Geography, Vol. III.

The Social Function of Geography. DR. TROTTER. Fourth Annual Year Book of the Herbart Society.

Relation of Geography and History. CHANNING. Proceedings of the N. E. A., 1895.

Physical Geography in Secondary Schools. A. P. BRIGHAM. Proceedings of the N. E. A., 1897.

Physical Geography: Its Possibilities and Difficulties. E. L. HARRIS. Proceedings of the N. E. A., 1895.

Laboratory Work in Elementary Physiography. CORNISH. Proceedings of the N. E. A., 1897.

Physiography in the Schools. G. L. COLLIE. Bulletin of the American Bureau of Geography, Vol. I.

The Use of Physiography in Geography Study. R. S. TARR. Bulletin of the American Bureau of Geography, Vol. I.

Laboratory Work in Physiography. H. B. KÜMMEL. Bulletin of the American Bureau of Geography, Vol I.

Introduction to Physiography of Land Forms. WM. C. MOORE. Bulletin of the American Bureau of Geography, Vol. I.

Hints to Teachers on Choice of Geographical Books for Reference and Reading. H. R. MILL. Longmans, Green. 94 cents.

This contains a very good list of references.

Index to the Literature of Geography. PETHERICK. Murray, London, 1887. $10.50.

About 5,000 books and pamphlets noted.

Bibliography of Education. W. S. MONROE. Appleton, 1897.

Classified Reading. ISABEL LAWRENCE. 1898.

A Bibliography of education containing a valuable list of geography references.

GEOGRAPHIC SOCIETIES AND PUBLICATIONS

National Geographic Society. Washington, D. C.

The National Geographic Magazine, issued monthly. John Hyde, Editor. $2.50 per year.

American Geographic Society. New York. Bulletin issued quarterly. $4.00 per year.

American Bureau of Geography. Winona, Minn. Bulletin issued quarterly. $1.00 per year. Edw. M. Lehnerts, Editor.

Every teacher of geography should be a member of this organization. It aims to better the teaching of geography by publishing articles bearing directly upon the work of the student and teacher, and by making it possible for teachers to obtain illustrative material from almost any section of our country.

Journal of School Geography. Lancaster, Penn. Ten numbers per year. $1.00. RICHARD E. DODGE, Editor.

The articles which appear in the Journal are written by eminent teachers of geography, and are very valuable aids to class and field instruction.

Geographic Society of the Pacific Coast. San Francisco.

Report of the United States Board on Geographic Names. Government printing office. 1890-91.

Geographic Names. National Geographic Magazine, Vol. VII.

American Geographic Names. COXE. Forum, Vol IV.

Geographic Journal of London. $5.50 per year.

Scottish Geographic Society. Edinburgh. Bulletin monthly. $4.50 per year.

Annals de Geographic. Paris. Issued monthly.

Societe de Geographic Commerciale du Havre.

Geographische Zeitschrift. Leipzig. Issued monthly.

Deutsche Geographische Blätter. Bremen.

Societe Royale Belge de Geographic. Brussels.

Bulletin de la Societe Royale de Geographic. Antwerp.

THE SCHOOL CABINET

BY BUEL T. DAVIS, OSHKOSH, WIS.

The school cabinet may be useful or useless, ornamental or unattractive, imparting life, interest, and animation or exerting an influence merely passive. There is probably nothing that can assist so much in the regular work of the school as a well apportioned, judiciously selected, suitably located, and skillfully managed cabinet. A cabinet, to be well apportioned and judiciously selected, must have due regard to the individuals and grade of the school, the subjects to be taught, and other surrounding conditions.

The use of the cabinet in the schoolroom must be duly subordinated to the class and the subject to be taught. It should assist in making the subject clear, objective, and real without consuming unnecessary time or space, or absorbing unduly the energy of either pupil or teacher.

The cabinet may assist in nearly every subject of the school and may be adapted to every grade. It may be put to active daily use, or it may hold the place of an ever present silent teacher, employing the eyes and odd moments in such a way as to be ever suggestive, and expanding and completing thought and ideas already present in the mind in crude or perhaps incorrect form.

The modern idea of school furnishing and decoration should provide a place for the school cabinet, especially selected to suit the grade of pupils and the course of study.

The cabinet of each room should be a branch or a special part of a general collection for the building or the central system. The make-up of the room cabinet should be changed from time to time as the work of the room progresses and interest in the subjects and specimens is exhausted. To promote this idea a constant system of exchange between grade schools, and between these and the central cabinets, can be kept up.

While the cabinet can be made to serve every subject of the course of study, there is no subject that can be so well and variously

served as that of geography. Each state, country, and clime can be made more real by an exhibit of real materials, mineral and organic products, showing natural production and progressive stages of manufacture. The work that can be done along these lines is almost endless. Care must be exercised in making selections of subjects for daily recitation, adhering to suitable centralization of thought.

The cabinet may not only contain materials of every conceivable kind illustrating products and industries, but may contain pictures and slides illustrating people and natural and artificial scenery. The central museum should be equipped with apparatus and auditorium for optical projection, and in proper grades the magnifying glass and microscope should find a place. The loan and exchange idea should pervade every cabinet collection, and every child and home should be glad to assist and contribute. Exchanges may be made not only among schools of the same city, but exchanges and loans may extend to different cities and may be national or even international in character.

The proper use of the cabinet and cabinet illustration may be made more practically effective than travel in the teaching of geography. This is especially true in these days of ready communication, and perfect and cheap graphic illustration and illumination. The American Bureau of Geography has a large field of usefulness before it in this one endeavor concerning school cabinets.

FLAX—CULTIVATION AND PREPARATION FOR MARKET

PHILIP EMERSON, PRINCIPAL COBBET SCHOOL, LYNN, MASS.

[This paper is part of a sketch describing the production of flax and its manufacture into thread, written to accompany an exchange set of specimens illustrating the varieties of flax and the steps in its manufacture. A similar account should be prepared in connection with all material that is to be listed by the Bureau for exchange. A parallel article, discussing the study of flax as a typical textile material, will be found in the Popular Educator for June, Educational Publishing Co., Boston, Mass.]

Flax is a smooth, slender, annual herb, with alternate, linear leaves, growing to a height of from twenty to forty inches. It is notable for the long, fine, tough bast cells of its fibrous inner bark, and for its oily seeds. Flax is only second in importance to cotton among vegetable fibers. The pith and ordinary woody fiber of the flax stem are surrounded by the long, tough fibers of the inner bark, and outside these, the ordinary bark and skin. The length of the bast fibers makes flax easily spun, and their surface character prevents their slipping, thus giving durability to linen fabrics. The fineness of the spindle-shaped bast cells, and thus of the fiber when repeatedly split, makes possible the finest thread and linen cloth, so that flax is the fiber of luxury as cotton is the fiber of the masses. The fibers are marked by solidity, because of the thick cell walls, and thus are strong and tenacious. They are supple as well, and may be bent sharply without breaking, so making their manipulation easier, adapting the thread to lace making, and adding to its durability. The variety in the length of flax filaments, in their strength, color, etc., adapt the fiber to a wider range of uses than cotton even. Among its products are lace, fine linens such as cambric, damask, lawn, shirtings, sheetings, handkerchiefs, dress goods, suitings, canvas, duck, embroidery flosses,

flax-thread, twine for use of shoemakers and harness-makers, fish-nets, warp in carpets, the body of oilcloth, and even rope and cordage.

Flax is the most ancient commercial fiber used by man, flax spindles and products having been found as made by Swiss Lake Dwellers of the Stone Age, and most fine and beautiful fabrics are among the early Egyptian remains. The distaff for holding flax fiber and the spindle for twisting it into thread are far older than their mention in the Bible or the days of Homer and the myth of Arachne, altho some tribes did not invent them and continued to simply twist the thread by rolling the fibers between hand and thigh. Savages early and widely discovered the strength of twisted fibers, using them for fish-lines and knotting these into nets; and, perhaps, they proceeded thence to woven cloth. Long before Columbus, the hand-turned spinning wheel for rapidly revolving the spindle was invented, and soon after the discovery of America the addition of the treadle for foot power secured its wide use. The two-handed wheel for spinning two threads at once, invented in 1765, was displaced at the end of the century by mills for spinning flax by power machinery. In America the spinning and weaving of flax was one of the earliest household industries, brought with the colonists and earnestly promoted from Virginia to New England, so that it continued in most sections until fifty years since, and even to the present day in the southern mountains. In Lee county, Virginia, in 1890, lack of railroads making manufactured goods costly, all families in the county raised their own flax, prepared and spun it, and wove their own bed and table linen, towelings, etc. Up to 1860 excellent flax fiber was produced in quantity in the United States, equal to that imported. The census of 1870 showed that a much larger quantity was produced, but it was carelessly prepared and of very poor quality, being intended for cotton bagging. Soon afterwards the duty on jute was removed, flax production rapidly decreased, and it was soon produced in only a few scattered and limited localities. However, flax continued to be raised, solely for its seed, over large areas, especially on the western prairies. Flax fiber is today raised in the vicinity of the Great Lakes, as the province of Ontario and state of Michigan, westward into Minnesota, and on the moist northwest coast of the continent. Flax fiber is mainly produced on the northern coastal plain of Europe, from France to Finland,

the westerly winds from the near-by warm waters giving the moisture and uniform temperature favorable. More than half the world's production comes from the northwest of Russia. Fiber is also raised in districts of southern Europe, as in parts of Austria. Japan produces fiber commercially. Flaxseed is produced largely in the black soil provinces of Russia, in India and Argentina, as well as our own west.

To secure the best flax fiber, careful agriculture is necessary. Since the roots are long, the soil must be plowed deep, and must be made fine by plowing and harrowing in order to easily admit the roots. To secure length and fineness of fiber, growth must be steady and continuous. The requisite store of moisture is secured by thoroly working over the soil as in gardening, then making the surface smooth and compact by rolling, soon after seeding, to prevent the escape of moisture. If the soil be too dry and limy the fiber is short, while if heavy and clayey the fiber is long but coarse. In spite of thoro cultivation and generous fertilizing, rotation of crops in a series of five to ten years is necessary to relieve the land from the burden of a continuous like demand. The various grains are used in such rotation, one aim being to kill out all the weeds; and clover is grown toward the end of the series, its deep roots decomposing and giving both room and food for the flax roots.

Russian seed from Riga is usually used, as it succeeds better in milder climates than native seed. It is sown broadcast and evenly, to secure uniformity in plants and fiber. If seed is the only product desired, thin sowing is the rule, thus admitting the light and causing the plants to branch low and freely, so that many blossoms and seed capsules are produced. If fiber is desired, the seed is sown more thickly, the plants reach up for light, the shade beneath the tops prevents their branching, and long, clean, slender, straight straw results. Too thick sowing causes the soil to dry quickly from the abundance of foliage, with its evaporating surface, and some plants die from crowding. In Europe after the plants are well up, they are carefully weeded by hand, working toward the wind that the plants may blow up again. Weeds use soil, food, and space; so vary the light as to cause the plants to branch with short, coarse fiber; and both interfere with the pulling, and cause loss of staple in separation. From fourteen to twenty-five cents per day is paid the children who weed flax in Belgium;

and as high wages forbid hand weeding in America, the land must be cleared of weeds and weed seed when flax is to be grown for fiber.

If flax is grown for seed alone, it is allowed to fully ripen. In America it is then cut with a machine. When the fiber is to be used for thread, as soon as ripening is well commenced, and while part of the stalk is yet green, the flax is pulled up by the roots in handfuls; and after dislodging the dirt against the boot, these are laid upon the ground ready to be bound with straw at the seed ends. In Belgium, after binding they are set in stooks, or bundles, opened out like an A tent, to dry. After drying, the stooks are tied in even bunches, or beets, and piled on two poles like cordwood, in hedges, with air spaces. Finally, they may be placed in stacks, which are carefully thatched above. In America the flax is commonly put into a threshing machine to remove the seed, and as the fibre is so broken and tangled as to be worthless, much is burned or used as bedding. A factory has recently been erected at Niagara Falls where flax straw from the Northwest may be used in the manufacture of paper. In Europe, while the seed is sometimes removed by beating the flax against a rock, the heads are usually drawn thru a hetchel or comb of tapering iron pickets, to remove the seeds, or between crushing rolls free at one end. After rippling, or removal of seeds, flax for fiber should be sorted as to fineness, length, branching and color, and because this is omitted in Russia, the product commands a lower price.

The fiber must now be separated from the woody matter of the core and bark without injury, and this is difficult since the parts are united by a sticky, greenish-yellow gum not soluble in water. While this may be destroyed by chemicals, the best and almost universal practice is to secure its removal by putrefaction, rotting or "retting." In Russia, America and elsewhere the straw is spread thin on moist meadows for dew retting, a ton to an acre, the rows being turned at times to secure more even action of moisture, and two to ten weeks elapsing during the process. In other countries, as Ireland and Holland, the flax is placed in the soft water of bog holes or artificial steep pools. The bundles of flax stalks are put in, standing, packed loosely, covered with straw or sods, and weighted down. When fermentation sets in and gas escapes, more weights are needed to hold down the swelling flax. After a time, a slight flow of water to remove the surface scum is

desirable. Several days having passed, and tests between the fingers showing that the wood and fiber separate easily, the flax is removed. If over retted the fiber is itself partly decomposed and spoiled. While dew retting is slow, increasing the time and labor necessary, it likewise gives no danger of over retting. Dew retted flax is so uneven from changing weather, and in different portions of the same stalk, that the fiber is not so valuable as that which has been water retted. This is uniformly strong, giving a round, even yarn, and thus commanding the higher price.

In Belgium, near the French border, is the slowly flowing river Lys, its sluggish waters allowing the mud to settle. For nearly twenty miles it flows over a thick bed of blue clay, and here for some reason, little understood, it so rets the flax as to produce the best fiber of the world. Flax is brought by car and train loads, and stacked or spread on both sides of the river, so that for fifty rods from the banks only flax can be seen in the fall. Crates with board floors and open sides of slats, are lined with burlap to keep out all dirt, then filled with flax, floated out and anchored in the stream, and weighted to immerse the flax. After some days of fermentation the crates are hauled out by a windlass, and the bundles removed to a field and broken up, that boys may again place them in stooks to dry. The stalks are often immersed a second, or even a third time, giving still better fiber. Altho the Lys is a dark and murky stream, with sullen flow, the water of an indescribable greenish hue and most pronounced odor of decay, the creamy color of its flax, used in the finest fabrics, has given it the name of "The Golden Lys."

After retting, the loosened fiber must be separated from the stalk by breaking and scutching. First, the woody matter must be well broken up. This is sometimes effected by beating with a kind of ridged mallet on a floor, or by a board lever working by hand into the space between two fixed boards as the flax is passed beneath the lever with the other hand, or by machines with feed rolls to hold the stalks and ridge rolls to break them. Scutching, that is, freeing the fiber from the shives or broken woody matter, may be roughly effected by knocking the broken flax against something, or by beating the shives out with a short wooden knife. In Belgium the flax is scutched by simple machinery. Several wheels on a rapidly revolving shaft have projecting blades of wood, three feet long and four or five inches wide; parallel and

close to these are vertical boards with wedge-shaped openings thru which the ends of handfuls of flax are passed. Thus the beater blades whip off all the woody portions, and tho some short fiber is also removed, this is saved for use as scutching tow. The fiber is now ready for the market and the manufacturer of thread.

The fine Flemish flax is not solely due to the use of the Lys for retting, but as well to the intelligent care of farmers and dealers at every step of the process, the result of generations of experience. Besides the favorable climate, moist and even, because of the westerly winds from the Atlantic, the undulating land of the northern plain of Europe with its friable loam of easy culture and porous subsoil, gives the even, moist soil necessary, with sufficient drainage. Altho heavy fertilization is necessary, and land is high, and the peasant farmers have not the machinery to easily work the soil or harvest and prepare the crop quickly and cheaply, the low price of labor and the accumulated skill and experience that ensure a certain product of high value, enable them to produce flax profitably.

In America, with cheap and fertile land, the best implements and machinery, intelligent and alert farmers guided by government scientists, and sections as favorable to the growth of flax as any in the world, we should become able to supply the home market for the product, and perhaps export flax to Europe, since the acreage there is decreasing. The need of diversifying our agriculture should aid to this end. As cotton manufacturing seems to be leaving New England for the South, perhaps the manufacture of linen cloth may in part take its place. In Canada and northern Michigan a communal system of flax culture is established, capital having established scutch mills. The farmers agree to produce so many acres of flax, and the mill supplies them with selected seed at a certain price and guarantees them a fixed price for the product, which they ret and clean carefully, for as in Belgium, the work of the farmer is finished when the flax is grown or pulled. Altho flax growth is decreasing in the East, hundreds of thousands of acres of flax are grown in the West for the seed, and with more care the fiber that is now wasted might be saved for profitable use and the increased wealth of the country.

The black soil provinces of Russia raise flax for seed only, because fallow or virgin soil is necessary for the growth of fiber, and cereals are more profitable. In the common soil districts to

the north, flax pays as well as cereals, and is grown largely, giving the best results on waste ground having rich surface soil. The cold climate to the north brings frost and snow even while the stalks are being dew retted, and much flax may adhere to the ground when removal is attempted. If water retted, the icy water prevents proper fermentation and so chills the workmen that they cannot give the needed care in handling the flax. Lacking long, warm days in the autumn, the flax is often dried in ovens after retting, and is injured by the smoke and heat, the color being darkened, and the loss of oily matter making the fiber comparatively hard and brittle. The ignorance of the peasantry precludes improved methods, and primitive ways on the farms are the rule, instead of machine preparation of the fiber as in Belgium.

In Ireland the acreage is decreasing slowly, and much flax is imported to the Irish mills from the continent, the price of flax having decreased, and a long rotation of crops being now necessary there. As the farms are small and the rotation long, flax patches of two acres or less are the rule. The work is largely performed by children, and as accounts are not kept, flax is often grown here at a loss, if the labor be given a proper valuation. The climate is so moist and cool in summer, and the winters so mild, that it is difficult to kill the weeds in either season, and many deep rooted perennial weeds exist. In this respect America exhibits a favorable contrast in each particular.

PRELIMINARY REPORT OF THE COMMITTEE ON LANTERN SLIDES

(Continued from page 85)

BY E. R. SHEPARD, OFFICIAL PHOTOGRAPHER, MINNEAPOLIS, MINN.

No. 31. "A Plowing Scene."—This scene is taken on Mr. Barnes' ten thousand acre farm at Glyndon, Minn. The teams were arranged for the purpose of photographing. This method of massing large numbers of machines under the direction of a foreman is but little practiced now. It is found that more and better work can be obtained by having each man work in a field by himself, as this shows more clearly the character and amount of his work.

No. 32. "One Thousand Acre Wheat Field, Red River Valley, Minn."

No. 33. "Lake Freight Carriers."—These freight boats are exclusively used in the transport of grains, ores, and lumber eastward, and coal and merchandise westward.

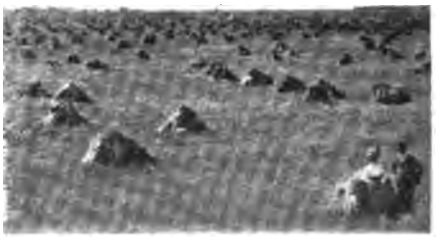
No. 34. "Packing Room, Pillsbury 'A'"—The largest mill in the world, having a capacity of seven thousand barrels of flour per day. The scene shows the sacking and barreling of flour.

(Note.—Arrangements were made to submit eight scenes from different countries of the world, showing the different methods of harvesting. The scenes are very fine and will be a most valuable addition to the series; but unfortunately the material has not reached us in time for publishing in Bulletin No. 2, tho the slides will be ready for distribution with the above scenes, and will be numbered 35, 36, 37, 38, 39, 40, 41, and 42.)

No. 43. "The Switchback, Great Northern Railway."—The view shows the spurs on the east side of the Cascade Range, at Cascade Tunnel.

No. 44. "The Great Northern Railway Switchback on west side of Cascade Range."—By means of the series of spur tracks shown in the above views the railway starts at the base of the

No. 31. **Plowing Scene, Glyndon, Minn.**



No. 32. **Wheatfield, Red River Valley, Minn.**

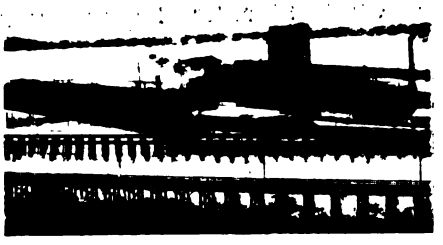
No. 33. **Freight Carrier, Lake Superior.**

No. 34. **Packing Flour, Minneapolis, Minn.**

No. 43. **Switchback on east side of mountains.**

No. 44. **Switchback on west side of mountains.**

No. 45. **Extinct Crater, Washington.**



No. 46. **The Railway Docks, Seattle, Wash.**

No. 47. **Transport Docks, Puget Sound.**

No 48. **The "Edzumi Maru."**

No. 49. **Port Blakely, Washington.**

No. 50. **Upper Lake Chelan, Washington.**

main range of the Cascades, rises one thousand feet to the summit of the pass, and drops to about the same level on the opposite side, within 3¼ miles of the starting point. The length of the spurs and tracks, constituting the entire switchback, is a little over thirteen miles in length, and the grade five per cent. With the help of two heavy engines the entire train is taken over the range at one time. (Note.—Scenes illustrating the "Building of a Railroad" are being selected for a subsequent report.)

No. 45. "Extinct Crater near Columbia River, Wash."—The scene is found in the midst of the basaltic formations which extend over much of northern and eastern Washington, east of the mountain range.

No. 46. "The Railway Docks, Seattle."—The scene shows the new Great Northern Railway Docks at Smith's Cove, Puget Sound. These have been constructed by Mr. J. J. Hill in the interest of the Oriental trade, which is so rapidly coming to be a factor in our country's commerce. The docks, built in a peculiar manner at great expense, are so constructed as to prevent the ravages of the teredo. They are the only docks having an elevator on the Sound.

No. 47. "Transport Docks."—By means of transports an entire freight train is carried across the Sound to Port Blakely saw-mills—the largest of their kind in the world—then loaded with lumber and retransported to the tracks, and started on their journey across the continent.

No. 48. "Edzumi Maru."—A Japanese ocean steamship, entering the Seattle docks. This vessel was loaded with tea.

No. 49. "Port Blakely Saw-Mills."—The scene shows boats from Norway and Germany, loading lumber for the European markets.

No. 50. "The Upper End of Lake Chelan, Wash."—The scene is taken from the summit of Round Mountain, 4,000 feet above the lake, and shows about thirty miles of its upper end. This lake has a length of seventy miles and a width of from one-half to two miles. In the upper sixty miles of its length, it is narrow and shut in by lofty spurs of the Cascades, reaching a height of over nine thousand feet, while the altitude of the lake is only 1,100 feet.

EDITORIAL

Acknowledgments

The Editor wishes to thank the members and friends of the Bureau for their many helpful suggestions and for their active support. The rapid increase in membership during the last three months has been largely due to their hearty co-operation. Superintendents and principals of schools, and instructors in high and normal schools have been especially active in recommending the work and publications of the Bureau, and many have secured descriptive circulars for distribution among their teachers and advanced students. A number of members expecting to work in summer schools have already expressed their purpose to call the attention of teachers to the merits of our enterprise. Such genuine approval and support from educational men and women interested in geography, must result in a large increase in our membership and a corresponding growth in the value of our work. The kind services of the Maryland Geological Survey, and of a number of railway lines must not be overlooked. The Maryland Survey has generously furnished some very acceptable photographs, and has kindly permitted Dr. Cleveland Abbe, a member of the Survey, to contribute some of the scientific results of his recent field-work. Messrs. F. I. Whitney, of the Great Northern, George H. Daniels, of the New York Central, George P. Lyman, of the Burlington, W. B. Kniskern, of the Chicago & North-Western, and George S. Marsh, of the Chicago, Milwaukee & St. Paul railways, have enrolled in the Bureau and claim the privilege of contributing to its success. A number of illustrations in this issue have been furnished thru the courtesy of the New York Central and Great Northern lines.

Associate Editors

The editorial staff of the Bulletin has been strengthened by the addition of John A. Dresser, of Canada, George P. Reclus-Guyou, of Scotland, and Robert T. Hill, of Washington, D. C. These men have enjoyed thoro geographical training, both in the class-room and in the field, and their contributions to the Bulletin will be of great

interest and value. Mr. Dresser is the principal of St. Francis College, Richmond, Quebec. His work in geology at McGill University and subsequently at Harvard, his experience as a teacher, and his recent field-work on the Canadian Geological Survey, have given him abundant opportunity to study important geographical problems. Mr. Hill, of the United States Geological Survey, is a leading authority on the geology and geography of the southern United States, Mexico, Central America and the West Indies. Some of the scientific results of his work appear in the publications of the United States Geological Survey, in the *National Geographic Magazine*, and in his book on *Cuba and Porto Rico with the Other Islands of the West Indies*. Mr. Reclus-Guyou is a nephew of Mr. Élisée Reclus, the distinguished geographer and author of that monumental work, *The Earth and Its Inhabitants*. He was educated as a civil engineer and obtained his degree at Paris. On leaving college, he was for some time engaged in engineering, and also did some scientific work in chemistry. But as time went on, he was more and more turned, under the guidance of Mr. Élisée Reclus, to the study of the earth as the fountain head of all synthetic knowledge. Five years ago, in Edinburgh, he came under the suggestive influence of Professor Geddes, and has since been working for these two men of powerful intellect. At present, he is co-operating with Professor Geddes in the organization of the Outlook Tower, the nucleus of a museum of great educational value, and at the same time is preparing maps and documents for Mr. Élisée Reclus. We heartily welcome our new colleagues, and take great pleasure in announcing their addition to the staff of editors.

Committee on Geographic Literature

The Bureau has been fortunate in getting Mr. James F. Chamberlain, of the Los Angeles Normal School, to accept the chairmanship of the Committee on Geographic Literature. The work of this committee includes the preparation of a comprehensive index of the most important books, reports, and articles on geography. The number of excellent periodicals alone, is so large that no one teacher, even if he gives much of his time to the work, can ever expect to find all of the many articles and illustrations of geographic value. Our plan has been outlined in the March Bulletin, and, in brief, is this: books, reports, and magazines to be indexed,

will be assigned to individual members who volunteer to take part in the work. Rules for indexing will be furnished by the Chairman, who also revises the several reports and arranges the material for publication in the Bulletin. Mr. Chamberlain is particularly well fitted to take charge of this work. With no other incentive than the promptings of his own deep interest in the subject, he has already prepared, single-handed, a valuable list of geographical references. In addition to noting the best books, he has also listed articles from government reports, geographic journals and leading periodicals, giving author, publisher, date and price. These references are arranged under twenty heads: Method, Primary Geography, Grammar Geography, General References, Physical Geography, Physiography, etc. Mr. Chamberlain's bibliography has been tested by several years of class-work in the Los Angeles school, and if published in book form, would be of great practical value to teachers who have access to libraries, or desire to select books for themselves. A short chapter from Mr. Chamberlain's bibliography is published in this number (pages 157-163). Readers of the Bulletin interested in the work of this committee, and willing to help index some publication, are invited to correspond with the Director of the Bureau or with the Chairman of the Committee. L.

For Improved Geography Teaching

As we survey the field of geography in relation to the teaching and study of the subject, two lines of needed reform suggest themselves: first, better prepared teachers; second, better equipped schools.

If geography is to be the commercial, the social, the cultural, the ethical power, which it can and should be, if it is to be a vital element in human affairs, it must be presented by teachers who have had special training for this work.

Our normal schools are doing much toward fitting teachers in this line, but only a part of our teachers come from normal schools. The universities and other higher institutions should offer thoro instruction in geography. Superintendents and school boards should demand of those who wish to make a specialty of geography, evidence of their ability to teach the subject.

Travel is of particular value to the teacher of geography, and he should make all reasonable effort to avail himself of its power. In order to get the most out of it, he should have had thoro prepa-

ration beforehand. He can then animate his work with a spirit which is born only of personal contact with that which is being taught.

Few schools are properly equipped for the teaching of geography. The program should be so arranged as to allow frequent excursions, and these should not be looked upon as interfering with the other lines of work, but rather as being aids to them. Good maps (raised, relief, and political), globes, charts, models, and other apparatus, are necessities if the best results are to be obtained. Unless the teacher is well prepared, he will teach *maps* and not *realities*, however.

Every school should have its geographic museum, containing material illustrating the most important products and industries of the world. Pictures will supplement this material, and, in addition, will serve a purpose which it cannot. They should be large, clear, and mounted upon cards uniform in size. A stereopticon is invaluable, and can be used in other departments of the school. Many teachers are not aware of the large amount of helpful material issued by the government. Much of this is to be obtained free of cost, and all at the lowest possible price.

Thru organization, and thru individual effort, much can and should be accomplished in the way of a more thoro preparation of the teachers and a better equipment of the schools. Let us strive earnestly for these better conditions, which will result in an awakening of the minds of our pupils to the lofty and ennobling thoughts which come thru a knowledge of the "Earth as the home of man."

C.

Notes for the Geography Class

In a wide region in Montana tributary to Billings, there has recently been a remarkable decrease in cattle raising, which has been shown to be due to an overstocking of the ranges, and a consequent injury of the bunch grass. Then too, this particular part of the Great Plains is too cold for successful cattle breeding, the ranges being stocked by importing young cattle from the east and south, which in a year or so are ready for the market. Close on the heels of this change comes the stocking of the area with sheep, which are easily bred on the ranges. So the industry on a wide area is rapidly changing from the production of beef to that of wool and mutton.

Last year the broomcorn industry of America was consolidated into a trust. The center of this industry and the region where the finest brush is raised is at Charleston, Ill. This year the trust has withheld the brush from the manufacturers, and the price has gone to an unprecedented figure. Recently the Chicago manufacturers have begun to import brush from Hungary at a very large profit. A factory at San Diego is reported as beginning to use the fiber of palm leaves, very plentiful there, using the Illinois brush merely for covering. G.

Suggestions to Teachers

Every lesson in geography needs to be illustrated in some simple manner. Objective illustrative teaching is apt to be good teaching in any study; it is a vital necessity in geography; hence the need of material in the form of specimens, pictures, maps and charts for the effective presentation to children of geographical facts.

In the upper classes the children should be expected to talk upon geographical topics without the teacher constantly asking questions. The writer recently visited a room where the pupils could talk for five minutes or more about different cities in Europe. The teacher and visitor listened, the children did the talking. That was the result of superior teaching.

In upper grades, write these questions on the blackboard: Where do the Boers live? The Tartars? The Tagalogs? The Reconcentrados? Give the pupil who can answer the four without study, some little reward or honor.

Which is the easier for the child to remember, that the Ohio river is about twelve hundred miles long, or that it is 1,265 miles long; that Pike's Peak is about fourteen thousand feet high, or that it is 14,147 feet high?

Some teachers are very successful in getting their pupils to read library books of travel. Such pupils become interested in geography and wonderfully intelligent on the subject.

Amateur photography can be made of great use in teaching geography. There is no art more fascinating than photography, but patience and perseverance are needed for success.

The time allowed for geography in a given month should be carefully apportioned so that no one subject will receive more consideration than its importance demands.

Inasmuch as so many people live in cities at the present time, should not more attention be given to the great cities of the world?

The daily, the weekly, and the monthly papers, supply a vast amount of excellent material with which to make geography full of interest.

Try the strength of your class after a three weeks' study of a country, by writing on the board a hard question for them to look up.

Local geographical clubs are most helpful in improving the teaching of the subject. Boston has a large and live one.

The teacher who travels ought to teach geography much better than the teacher who stays at home year after year.

History without geography is very weak, but geography can get along quite well without much history.

In the spelling and pronouncing of geographical names, it is well to follow the text-book used.

Ask the children to point from their desks towards the country which you are now studying.

Children are very social animals, and they like to have their teacher study with them.

In teaching geography, the letter killeth while the spirit maketh alive.

Imaginary journeys are greatly enjoyed by young children.

How many teachers make *home* geography prominent?

Try your children, and see if they can read a picture. K.

Geography as a Means of Esthetic Culture

Teachers are generally inclined to direct all their efforts towards the cultivation of the intellects of their pupils. Text-books on the various subjects of school study seem to be prepared with the same object in view. Both teachers and book-makers forget that the training of the feelings and will is also important. Or if they do not forget, they neglect those sides of the mind. This is a mistake. For as the mind is an organic unity, whatever cultivates the feelings, or emotions, cultivates the intellect also; and so it does the will, as feeling is the mainspring of action. Besides, it is the duty of teachers to bring all the refining influences they can, to bear upon the children under their care. The world is full of beautiful

objects, and to lead the learners to appreciate their beauty will add much to their own happiness, as well as to that of their friends and associates.

The teacher of geography has an excellent opportunity for cultivating in his pupils a love for the beautiful, as the study of the subject is the study of a series of pictures. Spring covers the earth with a carpet of the richest green, dotted here and there with beautiful flowers that appeal to the noblest in the nature of the child, no matter how lowly he may be. The trees that adorn the plains, clothe the hills, and climb the mountain-sides, are busy donning their new suits. They may almost be heard whispering to each other and urging haste. The streams, liberated from their icy fastenings, are celebrating their freedom with songs of rejoicing, as they pursue their way thru woodland and meadow. While the birds, not to be outdone in gratitude to Him who heeds the fall of the sparrow, unite their voices in strains of sweetest melody.

Summer strengthens and deepens the tints and hues which it finds upon its arrival, and adds coloring of its own. The bloom-laden orchards whose wealth of pink and white is equalled only by their fragrance, the ripening grasses and fields of wheat and oats with their alternating flecks of sunshine and shadow, the tasseled corn which bows politely to the passer-by, are objects of beauty. And so are the well-kept pastures with their sleek flocks and herds, which graze contentedly on the rich herbage or rest in the grateful shade. While the cozy farm-house and capacious barns, surrounded by stately trees, add a pleasing variety to the landscape.

Autumn comes with its russets and browns, reds and yellows, and paints the leaves and fruits in the most delicate and harmonious shades. Bush and brake glow with the warmest colors, and the maple rejoices in its golden foliage that retains the glory of the setting sun.

Even winter, altho much abused by poet and romancer, is not without beauty. The soft mantle of snow with which it charitably covers the dead past and protects the tender promises of the future is pleasant to look upon as it glistens in the sunshine. The icicles hanging from tree and bush sparkle before our eyes as if courting admiration, and even the ugly stubble is covered with an icy net-work of the finest weaving. And when over all is spread a

coating of hoar frost, softening the effect, we must acknowledge that winter presents a beautiful picture.

The teacher of geography has not only the variety of scenes presented by the different seasons, but he also has other resources for cultivating the esthetic nature of his pupils. The majestic river, peacefully pursuing its way to the ocean, bearing on its bosom the commerce of the nations, and the glowing sunset tinting the sky with golden hues, appeal to the finer feelings of the children. And the gloomy forest, the roaring cataract, and the solemn mountain, impress them with the sublimity by which they are surrounded, and tend to lift their thoughts to Him who created the heavens and the earth and filled them with beauty and grandeur for the benefit of His children. McC.

REVIEWS

The Physical Geography and Geology of Canada.—By G. M. Dawson; 1897. 10 cents. Geological Survey Department, Ottawa, Canada.

Amongst the Canadian publications of recent date which are useful to the teacher of geography, none are more serviceable in outlining the physical aspect of British North America than *The Physical Geography and Geology of Canada*, by Dr. G. M. Dawson, C. M. G., F. R. S., Director of the Geological Survey of Canada.

This is a reprint from *The Handbook of Canada*, prepared for the meeting of the British Association for the Advancement of Science, at Toronto, in 1897. Like all publications issued by the Geological Survey, its price is merely nominal, ten cents, and it can be obtained by addressing the "The Librarian, Geological Survey Department, Ottawa, Canada." A few excerpts will help to indicate its scope.

The area of British North America, i. e. Canada and Newfoundland, is 3,616,980 square miles, or an area somewhat larger than the United States,

including Alaska, and not much less than all Europe. The northern limit is about the seventieth parallel of north latitude, its southern the international boundary-line between Canada and the United States, which ranges from the forty-fifth parallel in the east to the forty-ninth in the west.

It consists of two grand physiographical divisions, separated approximately by a line running from the United States boundary near Winnipeg in a northwesterly direction to the Arctic ocean. The eastern division is of an older structure, having its mountainous features well worn down. It has few elevations of more than three thousand feet. On the west the formations are more recent, and comprise a broad plain, separated from the Pacific ocean by the great mountainous region of British Columbia and the upper Yukon.

These are further divided for more detailed description as follows: In the eastern division—1. The Acadian region, the extension of the Appalachian system into Canada, embracing the eastern maritime provinces and southeastern Quebec. 2. The lowlands of the St. Lawrence valley. These including the Ontario peninsula extend from Lake Huron to the lower St. Lawrence. 3. The Laurentian plateau, which includes more than half of Canada, or an area of above two million square miles. It is horseshoe-like in form, nearly enclosing Hudson bay, and has an average altitude of about 1,500 feet. In the western division—4. The interior continental plain. This important subdivision, which lies between the Laurentian plateau on the east, and the Rocky mountains on the west, is about eight hundred miles wide at the 49th parallel, but only three hundred at the Arctic ocean. The entire area is drained toward the north with the exception of some twenty thousand square miles belonging to the Missouri basin. 5. The Cordillera, or mountainous region of the Pacific coast, is four hundred miles in breadth and has a length of nearly 1,300 miles. It is a region of great complexity, and has bold and rugged features, many of its peaks exceeding eleven thousand or twelve thousand feet in height.

The description of these subdivisions, together with the main glacial features of the two grand divisions, occupy some forty octavo pages. Tho necessarily brief, it is vividly clear and exceedingly attractive in the manner of presentation. It is preceded by a general sketch of the drainage of the country. Of the greater rivers, the St. Lawrence has a drainage basin of 530,000 square miles, and is the largest river of Canada. The basin of the Mackenzie river occupies 677,000 square miles, the river being 1,800 miles in length, while the Nelson carries to Hudson bay the waters of an area estimated at 367,000 square miles. Besides the chain of boundary lakes, the height of each of which is given, there exist to the north and west other lakes, also of large dimensions. The altitude of some of these are: Lake of the Woods, 1,062 feet; Winnipeg, 710 feet; Manitoba, 810 feet; Winnipegosis, 830 feet; Athabasca, 690 feet; Great Slave, about 520 feet; and Great Bear, about 340 feet.

Thruout this interesting sketch the effect of the physical conditions upon the settlement and development of the country is kept prominently in view. Both the climatic conditions and the economic resources of the country are noted with as much fullness as the size of the work permits. It is, in fact, an excellent *vade mecum* for the teacher of the geography of the northern part of the continent.

JOHN A. DRESSER.

Five Months on the Yangtse.—By Capt. Blakiston and Dr. Barton; 8 vo , 1862. 18s. Murray, London, Eng.

Through the Yangtse Gorges.—By A. J. Little; 8 vo., 15-368, p., 1888. 10s 6d. Sampson Low, Marston, London

The Yangtse Valley and Beyond.—By Isabella Bird Bishop; 2 vols., 8 vo , 410, 365 p , 1900. $6.00. G. P. Putnam's Sons, New York.

Problems of the Far East.—By George N. Curzon; 8 vo., 20-440 p., 1894. $6 00. Longmans, Green & Co., New York.

China in Transformation.—By A. R. Colquhoun; 8 vo., 10-397 p., 1898. $3.00. Harper & Brothers, New York.

Siberia and Central Asia.—By John W. Bookwalter; 2nd ed , 8 vo., 41-548 p., 1899. $4.00. F. A. Stokes Co., New York.

Asia just now is one of the most interesting of the grand divisions, because there are found the great conflicts for supremacy and "spheres of influence." There the West and the East are contending in a great industrial warfare, the outcome of which no one can fully predict. This conflict has stimulated trade and travel, and the result is a long list of readable books upon different countries, especially upon China and Siberia. To teach correctly these countries, it is quite necessary to be familiar with some of the books to be mentioned.

Eastern China has been most fully treated by such writers as Williams, Smith, Cummings, Thomson, Meadows and Simon; but we knew little about Western China or the Upper Yangtse river till Capt. Gill, an English army officer, penetrated this part of the world and told us his wonderful experiences on "The River of Golden Sand," published in 1880. Capt. Blakiston and Dr. Barton followed Gill and published as a result their valuable and accurate work entitled, *Five Months on the Yangtse.*

A few years later Mr. A. J. Little ascended the great Chinese river from its mouth to Chung-king, longitude 107°, and wrote *Through the Yangtse Gorges*, a most interesting account of the difficulties of navigation above Tchang. This book is illustrated with numerous pictures, but is rather poorly printed. Mr. Little spent some time in Chung-king and very fully describes this treaty-port, which contains half a million inhabitants and is the commercial metropolis of Sze-Chuan, the rich province of Western China on the Upper Yangtse. In 1898 he took thru the gorges the first steamer which ever penetrated these upper waters; hence, his exhaustive chapters on this great river are most valuable reading and commend themselves to our confidence.

But the special meed of praise must be given to Mrs. Isabella Bird Bishop's two volumes, entitled *The Yangtse Valley and Beyond*, which have been issued this year from the press of G. P. Putnam's Sons. These books are so beautifully printed and illustrated by photographs taken by the author that it is a real pleasure to peruse them.

Mrs. Bishop followed the footsteps of Mr. Little up the Yangtse river, thru the wonderful gorges, into the rich and industrial section called Sze-Chuan. She traveled thru some portions of this country where no other European than missionaries had ever been, and she fully corroborates the wonderful accounts

given by the other writers mentioned, wherever their journeys coincided. Her special chapter (XII, Vol. I), on the rapids and trackers, is one of the most vivid she ever wrote, which is saying a good deal. These volumes treat also very helpfully of the Lower Yangtse, its upper branches, Chinese ways, food, roads, beggars, education, country schools, industries and fairs; of the opium habit, of all important cities on or near the Yangtse river, the great province of Sze-Chuan, and the Man-tze people in Eastern Thibet. An excellent map is found in volume one.

The government and political condition of China are constantly referred to in the above volumes but are more fully discussed in *Problems of the Far East*, by Mr. Curzon, which came out just before the Japanese war, and dealt most instructively with the causes of that conflict. Since then, A. R. Colquhoun, an Englishman, has brought forth his *China in Transformation*. This writer is a correspondent of the *London Times* and seems thoroly well-informed. He deals with all the provinces of China, giving condensed accounts of the drainage, the mountains, the eighteen provinces, the functions of the government, the officials, and the people. He praises the Chinese for their industry, docility, temperance, and patience. In one chapter he gives a fine description of Hong-Kong; in another he discusses very intelligently the present political condition of China, and states his belief that sooner or later there will be a conflict between the Teutonic peoples and the Slav-Latin races. The onward march of Russia cannot be stopped even by her own rulers, unless it encounters a solid barrier. She has already practically obtained Manchuria, holds Corea in a vice, has Port Arthur, and to-day seems to dominate China from Peking. "While England wants Chinese trade, Russia wants Chinese Provinces." "We will conquer China by railroads," the Russians say.

These ideas are corroborated in a remarkable book just issued from the press of the Fred. A. Stokes Co., written by Mr. J. W. Bookwalter, of Springfield, Ohio, a business man, who modestly disclaims any literary ability to write a book, and yet who can not only write a very readable text but has done the more difficult thing of carrying a camera, and, like Peary, making this noble instrument tell us a most fascinating and helpful story, to strengthen the text and help us to believe it. This finely printed volume contains over two hundred half-tones, which truly fortify the word descriptions and make an ideal whole. The plain title of the book is *Siberia and Central Asia*, but it describes most vividly the spirit of the new Russia in contrast even with what Mr. Kennan and Mr. De Windt found there a few years ago.

Mr. Bookwalter's book is divided into groups of pictures, by pen and camera, of the Trans-Siberian railroad, the Trans-Caucasus region, and the Trans-Caspian railroad. In traveling over this first mentioned road as far as Lake Baikal, he learned that it passes thru a rich, fertile, treeless, prairie country, almost exactly like our western prairies. The road, he says, is well built, has fine stations, and will be equipped with thru trains composed of sleepers, parlor, and dining cars having all the modern improvements. He saw town after town on this road which did not exist three years ago, but which now can boast of ten thousand, twelve thousand, and sometimes fourteen thousand inhabitants.

The climate along this route is temperate and enables the people to raise large quantities of cereals, cattle, and sheep. It will be able to support an immense population. Not one acre of land is sold to those who are not Russians.

If the proposed Chinese railroad is constructed it will be possible, with trains running sixty miles an hour and our fast steamers, to go from New York to Shanghai via Russia in fifteen days.

The Russians are very busy building other railroads. They have already trains running from Batum on the Black sea and from St. Petersburg, to Baku on the Caspian sea. Fine steamers carry the traveler across this sea and a train rushes across the desert to Merv, and further east to Bokhara, Samarkand, and toward Kashgar in Eastern Turkestan. All this means, Mr. Bookwalter believes, that Russia is slowly reaching out toward China and India, that is, to the absorption of Asia at her leisure. C. F. K.

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BULLETIN

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THE RECITATION IN GEOGRAPHY

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The recitation is the place of active mental contact between pupil and teacher. Both make special preparation for it as for an ordeal which is to mark a point of advancement in each. To the teacher it gives an additional insight into the growing condition of the child's mind; to the pupil its value is in proportion as it tests his ability of combining the printed page or the lecture with the results of his own observation and thought. That recitation is most successful which leaves the child with a clear, retrospective view of the lesson assigned. The mental vision is also broadened, and a feeling of strength and hope takes the place of uncertainty and doubt.

The recitation in geography does not differ in its aims from the recitation in any other subject. If there be a difference in method, it is because the facts of geography constitute a science, and must be studied and taught as such. By this I do not refer to text-book geography, which is but a compilation, but to the broader subject, which is the earth as modified and used by man. As the recitation in all subjects must be adapted to the subject matter, so geography has methods peculiarly its own. However, there are fundamental principles underlying all recitations that are applicable in geography. These are here enumerated briefly, in order that their bearing on what follows may be seen.

First, the recitation should include a report on something prepared especially for this day by the pupil. While no definite rule can be followed, as to order of recitation, before the work has been fully entered upon a running review of the last lesson and of parts needed especially for the day, may be found profitable. Whether the report of the preparation be full or partial, the teacher should never omit this part of the work. Home preparation, while subject to abuses, is absolutely necessary to the development of a student.

Second, it should include a welding of this particular knowledge with all previous knowledge relating to this subject. The welding process taxes the skill of the teacher as nothing else can. The Socratic method of questioning is herein its proper sphere, and no teacher, who has not given particular attention to the art of questioning, can produce the best results. The questions should not only be Socratic, but they should be asked in such logical order that the pupils will be led to see the relations of the subject.

Third, it should include some original work, prepared by the teacher to be given the pupil, testing his knowledge and his ability to think, and concluding with some form of original investigation by the pupil. This investigation in geography should be of the nature of field work, picture or object study, or a lecture by the teacher, which fits into the inquiry naturally aroused in the child. It will be seen that all recitations are similar in the first two points, and also that the preparation and recitation of pupils, on a given subject, do not constitute all of the recitation. Each kind of work requires a special kind of treatment, and to this we shall now devote ourselves. The different kinds of work requiring special treatment in the recitation are: 1.—Field work, 2.—Maps, and 3.—Pictures.

Field work.—For a long time, pupils in certain subjects, as botany, zoology, and kindred subjects, have been doing portions of their work in the field, either with or without the supervision of the teacher. Recently, since such emphasis has been placed on nature study and geography as a science, work in the field, under competent direction, has become a regular part of the curriculum in geography. Its value consists in the fact that it commands the whole child, and that it furnishes a study of geographic forces in their natural environment. The fact that it gets away from books,

and that it shows things as they are under normal conditions without being reduced or modified for purposes of illustration, makes it of sincere interest to the child, and, therefore, a powerful educative agency. In order to make it a success, it is necessary that the teacher undertake it with excessive earnestness, and that she maintain the belief strongly that it is well worth her time and attention. Moreover, she must not only plan definitely every lesson in the field, but the entire series of lessons, so that every one will fall into its proper relationship to the course of study.

Having definitely mapped out the number and object of the field lessons in the course, the teacher may now begin a thoro preparation for the recitation. The selection of the place to teach a certain thing well, is no small amount of labor in the average community. One main difficulty is that most places selected for such work are too complex, and show such a multiplicity of nature forces that it is bewildering to the child to attempt to unravel them. Having selected a simple landscape, illustrating the point in hand, the teacher should visit it alone and study it in detail, just as it is to be presented. No amount of general information about a community will compensate for a detailed study of the area where the lesson is to be given. If the lesson be on an industry, such as the manufacture of brick, or a bank, or a department store, or a railroad shop, the necessity for active recent study is all the more apparent. Having prepared herself for the lesson to be given, the next and most vital thing of all is to prepare the class for the journey. A review of the principles previously learned and of the principles to be illustrated in the field, a vigorous talk concerning the way that pupils are to conduct themselves and their investigations, and a statement of what will be expected of them in the way of reports, should be given just before starting. Each student should be made to feel an individual responsibility in the accomplishment of a certain work that has been set before him in the preliminary talk of the teacher. In the field the recitation should depend for a method on the circumstances which surround the place where the study is made. If the study be one of landscape, the teacher may lead by suggestive and thought questioning, and one by one, as the required ideas are developed, maps may be drawn, sections and descriptions made, and the work completed by drawing a conclusion from the area studied.

However, if the field work is in a factory where the noise or proximity of workmen would prevent the personal observation and questioning that I have indicated, the students may be sent into a room with instructions to observe a certain force and watch its result. When they come out, the questioning for the information and conclusion should be made, so that the pupils may carry clear and definite notions away with them. Likewise, in any place where field work is done, the method would be similar; but it should be borne in mind, always, that the conclusion must be the result of the student's own work and not dictated by the teacher.

Full notes should be taken of the work done, and on the following day most of the things observed, as well as the conclusions drawn from the observations should be briefly reviewed in class, using only the most important observations as a basis for conclusions. From this review there may be assigned, for future preparation, an essay on a part or the whole of the subject covered by the class in the field. These essays, at the proper time, are to be collected, corrected and returned for review; a field lesson may therefore serve as a basis for three or four recitations in the class room.

It would seem, from the fact that geography is so closely connected with nature and has so many illustrations and so much illustrating material in reach of both teacher and pupils, that the entire course should be based on nature study and field work. Such a course was planned in 1893 by the author of this paper and Prof. F. E. Holiday, of Cambridge, Mass., and introduced into the public schools of Warrensburg, Mo. The effect was so great that pupils of the fifth grade were by far better prepared for history and for all subjects requiring a knowledge of geography, than pupils commonly are when they enter the high school. But better than the knowledge of the subject, they had the ability and the tendency to go direct to the source of information and thus find the truth about any point in geography which they did not understand. Such a course of study, with modifications to suit the surrounding circumstances, will produce an effect that will be ample reward for any teacher who has the inclination to develop it in school.

Maps.—To produce a successful recitation in map study is not an easy thing to accomplish. To have the child study a map at home, finding the answer to certain questions by tracing the

map with the index finger, has long since been proven unsatisfactory by most teachers; particularly so, because it has been considered such a drudge by the pupils. How to transfer enough of the map to the mind of the child, so that he can use it as a means of reference but not over-burden his mind, is the result to be wished. In striving for this result, let us remember that to the average child the map is a combination of colors on paper, presenting to him no real life nor interest. It is necessary to have him look at a map with the teacher, or under direction of some kind, and reproduce the entire surface in his imagination, in terms of the country surrounding his home. Such a course would not involve the child in the miasm of despair over memorizing coast lines, mountain ranges, rivers, etc. By studying these forms in miniature in his own neighborhood, he is made able, thereby, to discard the colors on the map and to reproduce the landscape covered with broad expanse of prairies, most prolific woodlands, dark sombre forests, turbid moving rivers, darting mountain streamlets, noisy rushing cities, innumerable toiling men, and all the industrial and commercial transactions common in the world about him. The map is thus made to represent a theater of activity of man and nature without which the area would be of no real value, if it were possible for it to exist in such a condition.

A child may be led, by proper training, to interpret a map and replace upon it all the notions in the mind of the original maker of the map; and while this reproduction of maps is not at all times necessary to their use in geography, it is extremely valuable as a help to the memory and as a developer of the imagination. In the sister study of geography, history, this interpretation is extremely valuable, and the more vivid the reproduction of the map, the more thoro the understanding of the historic fact, and the longer it will remain in the memory. This is a fact, which is learned by students of history often too late to prevent their disgust with a subject which has the highest interest, both intellectual and moral to the student.

The method of recitation should, therefore, involve a reproduction not only of relative position and of distances, but of landscapes, cities, and railroads. The following method of map study is given merely as a suggestion in this direction. In the second grade, pupils measure the room, reduce it to scale and map it. When this is thoroly mastered, let the yard be measured and

mapped in the same way. This brings to the child a certain conception of a map, but it is not complete. To complete it, he must understand relief form, and for this purpose, in the third grade, he studies the hill and the stream, maps them to scale, and indicates their slopes by contour lines. These contour lines will be few and perhaps imperfect, but will serve as a basis for the interpretation of maps made by others. In the maps of the book, let the map questions be discarded altogether, and let the first exercise be a description of the landscape as the child gathers it from the map. This recitation could be had with book open and the wall map unfolded. After the class and the teacher have gone over the reproduction of the map in detail, then the book could be closed and the student asked to reproduce, from memory, parts of the original landscape.

No one will doubt that the more the imagination can be brought into the recitation on maps, the more successful will be the result of the study; and the best way to develop this imaginative reproduction is by constantly requiring it in all map study. After the interpretation of a map is a part of the child's skill, maps can be used for a great many things in almost every subject. The child's knowledge of map construction and especially of map interpretation, becomes part of his intellectual equipment to be used daily, almost hourly, during his entire life.

Pictures.—Likewise, pictures become fruitful sources of study in geography. They appeal to the imagination in terms of the child's own mental vocabulary. A picture well studied, is worth pages of descriptive matter; but pictures unused or poorly used, represent so much waste of printers' ink. Pictures may be assigned for home study; and the subsequent recitation may be a written or an oral description, or a blackboard sketch illustrating the topic under discussion. Even with very small children, some method should be pursued in the study of pictures. The following directions are suggested as an outline toward which the pupil might work in the intermediate and grammar grades: 1. Take a general survey of the entire picture, noting its contour and perspective. 2. Notice the artist's position in the picture, find his object in making it, and study it from his standpoint. 3. Study the details of the picture, and try to reproduce, in imagination, all the surrounding conditions supposed to have been present. 4. Study especially some of the particular portions to which attention may afterwards

be called, making with each a comparison of other pictures previously studied. 5. Remove the picture, study its lessons, and reproduce in a short written description.

For this study, pictures may be mounted on cardboard or mat, and covered with glass and bound with gummed paper if necessary. These may be passed around the class or kept in a part of the room to which pupils may come for study. In the recitation these pictures may be reported on, and after each description has been read, a general discussion will fix the points which the picture should illustrate.

After recitations are made satisfactory in field work, maps, and pictures, the problem of geography is solved, so far as pupils are concerned. All description in geography may be related and correlated with these fundamental elements. Geography, thereby, becomes a study of the relations that the world sustains to man, and that man sustains to the world.

SUGGESTIONS IN GEOGRAPHY

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This great round world of ours, with its millions of inhabitants, offers so wide a scope for suggestions in its study, that one is appalled by its largeness. To all, geography in the elementary school, is the broad geography. To study our "earth in its relation to man," means not only the surface of the earth with its plants and animals, but a digging thru the surface into the interior, and a trip upward to the clouds. We must watch the work of the great sun, and experiment in this work. We must follow the tiny rain drop in its course from the clouds into the great ocean, and back into the clouds. "Old Boreas" must relate to us simple, interesting stories. The parks about us will tell us much of the information we seek. The story of ages will be told by the waves that dash upon the sea or lake shore. What nature will not give us, pictures, books, and maps will. Good geographies come pouring in upon us, until we have so many excellent ones, we know not which to choose.

In the study of any subject, reality is what all children demand. We teachers ought to appreciate this fact, and try to

make every recitation as real as is within our power. Imaginary trips, in the class-room, must take the place of reality. A child's interest is thoroly aroused by the mere mention of such a trip, and the taking of it in the school-room gives to him not only a happy recitation, but leads him into the habit of individual thought and action.

How many interesting facts may be gained from a successful journey with that small bag of rice which the sea captain brought from Madagascar to the South Carolinian governor. From one of these small, white grains, we may not only study geographical position, but plant-life, climate, soil, and people. Imaginary trips in our own and foreign lands will prove pleasant occupation. The study of industrial and commercial life from visits to factories and stock rooms, is beneficial to the child. Knowledge gained by the actual doing and seeing, is that which will be everlasting.

Children must be made to feel that the class-room is theirs, that they may handle and use all apparatus, books, and maps with care, but with perfect freedom, and that the teacher is ever ready to assist in the answering of difficult questions which may arise in her children's minds.

When the child begins the use of a text-book, he must be impressed with the thought that his one book is simply a reference book, to be used together with many other books in the geographical library. Let us work for the broad mind, not the narrow mind which will say "The book says so." How often this very expression escapes the lips of our children, only to be censured. But do we censure ourselves for not instilling within the young a broader idea of a subject? That we may do this successfully, we must teach in the broad way, leading our children into every possible avenue of investigation, our one thought being the independent thinking child.

The expression of ideas on paper, in composition or map form, is a good test of knowledge. The child who can intelligently express in writing ideas gained orally, is without doubt the thinking child. The use of the blackboard for illustration work by both teacher and taught, is invaluable in the study of geography.

Several years ago the tendency in the teaching of geography was toward political, to the exclusion of natural geography. Now the tendency is toward physical geography. While geography for

the little ones must be natural, as the child advances, there must be a combination of the two. Until we may combine successfully the physical and political, geography will not truly be "The study of the earth in its relation to man."

No matter what or how much we teach in any subject, let us have in mind "The whole being." Let us help our children so to lay the foundation of life, that it may never totter. Let us send into the world the man or woman who will shrink from no exertion, be dismayed by no difficulty, and who will look backward and say, "I thank you for my strength."

GEOGRAPHY MADE ATTRACTIVE

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In considering the subject of geography, we ask ourselves the questions, "Why teach it at all?" "What purpose do we hope to serve in including it in our course?" We have seen, in reference to the teaching of mathematics, for example, that altho there are two distinct purposes to be kept in view—the practical use of the study, on the one hand, and the indirect mental discipline afforded by it, on the other—the second object is the more important. Not so with geography. The chief object in teaching geography is to have certain facts known, because those facts, however learned, have a value of their own. We live in a beautiful world—one marvelously fitted to supply our wants and to provide us with the enjoyments of life—and it seems fitting, if we would be worthy denizens of such a home, that we should know something about it; what it looks like; what is its size; what resources it contains, and what kind of people inhabit it. To know these things we must study geography. If any mental discipline be derived from the teaching of the subject, it is well; but the primary object is, as I have said, to become acquainted with facts. Tho much of the result we hope to gain, belongs to the memory only, there is also opportunity for appeal to the judgment and the imagination.

Geography is often the favorite subject with the most superficial and mechanical teachers. Fitch says, "It is in fact the one subject in which the maximum of visible result may be obtained

with the minimum of intellectual effort. To give a few names of places, and point them out on the map, is the easiest of all lessons; and what is more to the purpose, it makes a great show when it is learned. And when I ask a teacher, what is the favorite subject of pursuit in her school, and she tells me it is geography, and afterwards I find that what is called geography means merely the knowledge of names and the power to identify their position on the map, I always draw a very unfavorable inference respecting the character of that school as a place of intellectual training; for I know that such information may have been imparted without the least exertion of educating power on the teacher's part, and that a great deal of such knowledge may easily coexist in the learner's mind, with complete mental inaction and barrenness." Mr. Fitch's observation has been my own. If, however, this study be rightly taught, the child's mind may not only become, thru it, a storehouse for the accumulation of much useful knowledge, but its development, thru this channel, may be greatly stimulated.

In beginning the study of geography, then, we should make it, to a great extent, pictorial and descriptive. Commencing with the elements of natural scenery which fall under the child's observation, and carefully noting their distance and relative direction from the school and from each other—the hill, the mountain, the brook, the river, the plain, the forest, the island, the cape, the cliff, the sea, the village, and the city; the productions of his own state or country, its animals, its trees, its flowers, its herbs, and its metals; the people who live about him, their occupations, their customs, their habits, their food, and their clothing—an interest in investigation, and a desire to discover for himself, is established in the child. These discoveries with regard to his immediate surroundings and the state or country in which he lives, will lead him to realize the corresponding features of other lands and climes, by comparison with what he has observed in his own. We should ever set before him, when possible, specimens and pictures of foreign products and scenes, and, for the rest, appeal to his imagination to take off the impressions from our vivid descriptions.

In order to accomplish good results, the teacher must fill herself with her subject, and cultivate to a high degree the art of description. Such is an outline, in brief, of the course the instruction should follow in the first year of the child's life. As I have

said, a lesson in home geography should be the first in a geographical course; and to make these first lessons intelligible, the school should be provided with various objects collected into a museum—such as kinds of plants, woods, articles of food, clothing, fuel, implements of labor in miniature, models of shelter of all countries and nations, pictures of which may easily be obtained —a modeling board and, of course, a blackboard.

TO TEACH POSITION

First train the child to observe and describe the position of objects on the table in front of him, using the terms right, left, front, back, front left-hand corner, back right-hand corner, etc. Then let the teacher represent the position of these objects on the blackboard. Afterwards, have the pupils copy the representations from the blackboard on their slates. Train the pupils to notice and describe the positions of the parts of the class-room, and of the principal articles in it; as, door, windows, blackboard, seats, tables, chairs, desks, closet, etc. An outline of the school-room, with the positions of the articles in it, should be sketched by the teacher on the board, and reproduced by the pupils on their slates. Following this, the pupils should be taught the location of the streets near the school, and required to observe and tell on what streets they go while on their way to school. The terms of direction may be introduced at this stage—east, west, north, and south—and the "points of the compass" taught. Represent the location of streets and buildings near the school, etc., on the blackboard, and let the pupils copy them as before. The "points of the compass" should be taught by leading them to know the actual bearings of their own school-room and the surrounding streets and buildings. Review "the points of the compass" until the pupils are able to name any direction as the teacher points, and to point in any direction named. Sometimes a little song or game in connection with this exercise will impress it upon the child. It is important to lead the pupils to learn the direction of prominent buildings; as, churches, post office, hotel, railroad station, etc.; or of villages, farms, groves, forests, streams, etc., within range of their observation.

THE NATURAL DIVISIONS

Take journeys with them about the town in which they live. From the gentle eminence on the sides or summit of which they see

the cattle grazing, they can pass to the hill to the top of which they may take a summer day's climb, leaving fields, cattle and homes in the valley below. Thence they may be transported, in imagination, to some lofty peak of the Alps, with its fertile valleys and lower slopes, its hardy forest above, and its top lost in eternal snows. Having reached the hill, they should be led to observe its shape, whether it be broad and flat, or steep and in part precipitous; whether it be a single hill, or one of a range; the material of which the surface is composed; the covering of its surface whether grass or heather or shrubs; the animals that may be browsing on its slopes; the streams which may leap down its sides; the climate, varying with the height till they reach the cool of the summit; the corn fields at its base, extending, more or less, up the slope; then the woods and, lastly, the grass; the toilsomeness of the ascent and the time required for it; and perhaps the metals and the minerals dug from the bowels of the earth. With the modeling board, let the teacher make before the class, in sand or soft clay, a rough representation of a range of mountains or a group of mountains and valleys, and then show how water comes out from the glaciers or springs, and sometimes tumbles over steep rocks, and finds its way down the sides until it forms a river or lake. Draw out from them that a river will be more rapid in a steep valley, and more sluggish when it flows thru a flat country. Illustrate this by placing a cylinder on an inclined plane, then on a nearly level plane. Lead them to see that it will increase in size as it goes on and receives other streams, and that the wide openings by which it enters the sea, are often convenient places for the formation of harbors and for commercial stations, but that sometimes it cannot find free course and is pent up between hills and rocks.

What a variety of instructive matter is suggested by this little stream: its source, the little spring welling forth amongst the hills from the bosom of the earth; the descent of the many small rills from the mountain side to the valley; the length, depth, and gradual increase of the main stream; the influence of the season of the year upon it; the smooth, clear, low water in summer and the dark, swollen, angry torrent in winter; the character of the land thru which it flows; the uses to which man puts rivulets and rivers—the former a source of power for industrial purposes, the latter, the highway of commerce and of travel—both adding to the riches and civilization of a people. All these considerations are involved

in the idea of a "river," and there are few of them that cannot be illustrated by reference to the brook that may pass the school or the river that may flow thru the city.

CLIMATE

Suppose the subject of the day's lesson be climate. On a winter day, let the children observe the thick flakes of the falling snow whitening the face of nature, or the hardening influence of the clear frost covering lakes, ponds, rivers and roads with ice; the rapid motion and the thick covering necessary for comfort; the fires we need in our houses; the care we need to take of our animals; the unproductiveness and barrenness of nature at this time; the short day and the long night. On a summer day, let them notice the mild air, the clear, blue sky; the moderate motion, and the lighter clothing; the face of nature beaming with animal life, and clothed with its rich garment of green; the treasure in the fields of budding trees and singing birds and blooming flowers; the long day and the short night with its insect life about us—mosquitoes, fire-flies, grasshoppers, caterpillars, etc., etc.

In these lessons on geography, scientific order is of little consequence. The true point of beginning is with what the children see and know. Country children are much keener observers of nature than are their city cousins, because they live in the fields and woods and hold sweet converse with the birds, the trees, the flowers, the insects and the rocks. They can tell the names of the trees by their bark or leaf, the names of the birds that sing in the woods, and the name of the commonest weed that grows on marshy bank, by limpid stream.

It is when such a series of "home" pictures as I have suggested are presented to the child that his imagination is aroused and he can take wings to other lands. He can expand the idea of the river at home till it reaches the Rhine, with its castled banks, or the Nile, with its annual overflow and symbolic lotus, or the Mississippi, stretching thru fertile valleys and known as the "Father of Waters," or the Amazon, with its wealth of forest. He can picture the mountain at home, till he can see the Alps with their rugged peaks and snow-capped summit, their fertile valleys and lower slopes and their woods above, reaching upwards toward the everlasting skies; or till he can conceive Etna with its teeming sides and magnificent prospects, and the smoke rising from its volcano top.

Again, from the winter day at home he may realize the dreary desolation of the Arctic Zone with its freezing temperature, its wilderness of ice, its stunted vegetation, its dearth of animal life, its short, cheerless days, and its humble skin-clad dwellers. Then can he be led to contrast his own life with these, and thank the Giver of all good that he lives in such a land with such surroundings and comforts. The summer day, at home, may lead him to fancy himself beneath the scorching blue sky of the tropics, with the want of rain, the rapid and abundant growth of plants and animals, the overpowering heat of day and the dews of night, and the jungle or the desert.

To have the means of describing the different regions of the earth more particularly, the teacher should proceed with a series of object lessons on their productions. Thus, the lion, elephant, camel, tiger, wolf, bear, hyena, kangaroo, buffalo, reindeer, dog, sloth, serpent, whale, shark, eagle, vulture, ostrich, etc., are, for geographical purposes, so many types.

So in the vegetable world are the palm, olive, the breadfruit, the vine, the cotton-plant, the tea-plant, the coffee-plant, the sugar-cane, rice, maize, cinnamon, cedar, mahogany, and the like. Children should be encouraged to make collections of such things as can be used in these lessons. It is the custom in many schools to make exchanges of products between states or countries, and the old-fashioned product chart is not only an ornament to the school room but also a means of cultivating an interest in this too often dry and uninteresting subject.

So with respect to man and his habits would be a series on the articles of food, clothing and building. During this course of instruction the only maps used are blackboard sketches or sand-table sketches and pictures—pictures of objects such as have been alluded to, and pictures of scenes typical of countries. The map of Arabia for the primary school should be a desert scene, exhibiting the general features of the desert and the sky, the caravan, the camel, and the Arab himself in his native costume. A map of Egypt would represent its river and its pyramids. India would be pictured by its rice fields, its jungles with their fierce inhabitants, and its mountain passes with their elephant trains. China would be represented by its tea plantations; Australia, by its bush, with the natives and the kangaroo; the South Sea Islands, by an assembly of natives on land or in their canoes; South America, by its

forests and its pampas; North America, by its cotton and sugar fields; the Indian Territory, by its prairies and its buffaloes, the last of which are extinct; the Esquimau, by his sledge and dogs; Turkey, by its mosque and worshippers; Spain, by its wild mountain pass and picturesque traveler; Switzerland, by its jagged peaks and chamois hunter; Italy and Greece, by their ruins; Lapland, by its reindeer and sledge; Great Britain, by its river scenes, crowded with shipping, or its pictures of the busy factory, its pastoral and its agricultural life.

In the absence of other pictures, every teacher can easily make a large collection out of illustrated papers, magazines and books worn out and tossed into the attic. These should be neatly pasted on cardboard and classified. One set may be used for representing landscapes, another for water views, others for shelter, cities, animals, plants, races of men, and the various countries. The pictures relating to each country or state should form a separate series, as the cities of England should be separated from those of Spain. Children will be glad to help the teacher make such a collection, and for the sand table many objects may be cut from pasteboard and paper to represent the lesson. The ingenious teacher will be able to supply all she needs, and in her summer journey may add greatly to her collection and the children's delight.

The geography of the primary school is thus a series of object lessons connected by a geographical link, and prepares material for the more advanced study of geography.

With the advancement of the pupils, we take up the definitions relative to the forms of land and water. These should also be represented by pictures and drawings upon the blackboard; then the teacher should show how the same is represented on the map, after which the definition should be taught. As the characteristics of each form of land or water are learned the pupil should be required to go to the map and point out several of each class.

Geographical cards will be found of great assistance as pictorial and map representations to illustrate these definitions. Those by C. H. Colton, New York, are among the best. Following this, the name of the town, village, or city, and of the county and state in which the pupils, live should be taught and their location shown on a map.

In teaching the shape of the earth by means of a globe, lead the pupils to compare a marble with an orange, and the orange

with a globe, and thus to notice that each one resembles the other in shape only; also that each differs from the other in size. By this means prepare them for understanding that the globe represents the earth only in shape. Next lead the pupils to compare the outline forms of the grand divisions of land and water, and of islands represented on the globe, with their corresponding representations upon hemisphere maps. Talk with the pupils about people of different races and nations and point out on the globe, also on outline maps, the location of the countries where each may be found, as Africa, the home of the colored or negro race. Proceed in a similar manner with the most familiar animals and the most common productions of the different countries.

It is of the greatest importance that Geography should be so taught and reviewed as not to leave in the minds of the pupils a mere collection of facts without mutual relation or dependence, or, as the "new education" puts it, without these facts being correlated. The child should, from the first, be led to consider the earth as man's dwelling place, its motions as bringing him the necessary vicissitudes of day and night and the changes of seasons, its land surfaces as the chief theater of animal and vegetable life, the ocean as the world's great highway and the exhaustless source of clouds and rain, so necessary to every form of life on the land surface. He should be led to think of the great permanent air currents as carrying to the land the moisture from the sea, the mountains as its condensers as well as the chief source of mineral wealth, the springs and rivers, with their branches, as carrying back again and over the land the ever circulating water of the ocean, and of cities as towns, not as black dots on a map in colored patches which he has learned to call countries, perhaps near some crooked black streaks, which he has learned to call rivers, but as the centres of social life and development, the seats of government, and the crowded, busy hives of human industry and intelligence, and marts of trade.

The first requisite for the successful teaching of this subject is a spirited and intelligent teacher, a wide-awake, enthusiastic, magnetic spirit who will be truly a guide to the pupils thru their journeys and investigations, infusing life into every stage of advancement.

Until I began to teach the subject, I hated it, because it was made so distaseful to me by its manner of presentation, in the

hands of a mechanical teacher. The only things I remembered about it were the capitals of the states and countries, which I learned when three years old by hearing a class in geography, in a school next door to where I was boarding, sing them. I learned the jingle, and the names remained with me.

The accessories to a wide-awake teacher should be, as I have previously stated, objects, pictures, a colored board of some soft tint pleasing to the eye, and a modeling board for primary work. For a kindergarten class, individual modeling boards, tin pans in size about 12x15 inches, are preferable. Later in the course should come a globe, a tellurian for explaining the succession of day and night and the change of seasons, outline maps, which should not take the place of those made by teacher and pupils, product charts made by the pupils, a good text-book in the hands of the pupils, a set of encyclopediæ, and various reference books. Our World, Scribner's Geographical Readers, Colton's Geographical Cards, and King's Geography, among others, will be found valuable aids with the younger pupils. As the pupils advance, topical outlines should be prepared by teacher and pupils and used in recitation. In reviews, much interest may be awakened in giving variety to the exercise, by the introduction of games, matches, and journeys from place to place on the map. Compositions on geographical subjects should also be written. These may take the form of description of some object or place, or narration of an event or journey, either in the form of essays or of letters for newspapers.

In the primary grades these compositions might be based on the subjects given in object or conversational lessons, namely:

(*a.*) Common Substances—glass, iron, coal, silk, money, etc.

(*b.*) Natural History—trees, flowers, animals, wood, etc.

(*c.*) Food and How to Produce It—wheat, oil, meat, honey, etc.

(*d.*) Manufactures—glass, steel, cloth, pottery, etc.

Also little excursions, real or imaginary, taken by the children. Weather charts should be prepared.

GRAMMAR GRADES

FIFTH YEAR

(*e.*) Natural Phenomena—winds, storms, change of seasons, sunrise, sunset, etc.

(*f.*) Forms of employment—farms, vineyards, life in a factory, a mine, a military station, a school, a studio, etc.

SIXTH YEAR

(*g.*) Construction of Simple Machines—a hinge, a knife, a lock, a watch, a pump, a gas meter, a pulley, etc.

(*h.*) Incidents of Travel—a voyage, a mountain ascent, a polar expedition, a shipwreck, etc.

SEVENTH YEAR

(*i.*) Local Events—a famine, a harvest, an exhibition, a festival, the construction of a new railway, an earthquake, etc.

EIGHTH YEAR

(*j.*) Events in National and Municipal Life—an election, the Constitution, the Census, the opening of Congress, the two Houses of Congress, etc.

(*k.*) Buildings and Public Monuments—their architecture and their history, etc.

A young girl taking for her subject "A Summer's Ramble" may find much food for the imagination or for her descriptive powers as she revels in the pleasant valleys of some quiet retreat, basks among the lovely hills, climbs the mountain peaks, sails on the picturesque rivers, gathers shells by the seashore, and returns home refreshed in body and mind, and with higher conceptions of the Great Artist "Whose fingers touched the canvas of Nature and evoked such beautiful creations."

You will see that the filling in of this outline requires an extensive course of instruction. Should the pupil leave school without advancing further, he will carry away with him such a knowledge of the subject as will serve most of the purposes for which geography is taught in school. He will know enough to read a newspaper with intelligence, to listen to discourses on subjects of general interest, and to take part in those public or private discussions which enter into the public life of a citizen of a free country; it will further enable him to understand and sympathize with the benevolent schemes of missionary enterprise pursued by the Christian church. The teacher who thus makes it her aim to inform her pupils in the broad elements of physical, mathematical, political, commercial, and, if we may so call it, *ethical* geography, thru which his thoughts are directed thru Nature to "Nature's God," and who looks upon the geography of names and locality as of value only in a subordinate degree, will confer a service upon the child whether as regards his education, his information, or the development of his sympathies, infinitely

beyond what she would do were she to store his memory with the exact height in feet of all the mountains, and the length in miles of all the rivers between the north pole and the south, or the exact areas of all the countries, the names of all the towns, capes, gulfs, bays, islands, and lakes. and the numbers of all the populations between New York and New York again.

When Geography is thus taught, it is one of the most interesting, important, and practical studies.

RECAPITULATION

HINTS AND DEVICES

1. Object Lessons.
2. Conversational Lessons.
3. Map Study, thru printed outline maps, or those made by the teacher and pupils.
4. Compositions.
5. Spelling matches of geographical names.
6. Description of course of a ship.
7. Each pupil names some city, state, etc., and describes it. A second pupil gives a name commencing with the last letter of the word given by the first pupil.
8. Each pupil writes a question which shall be the lesson for the following day.
9. Pupils question each other in turn.
10. Recite from map, while drawing it, by topics—one pupil drawing outline, another coast line, etc.
11. Geographical enigmas.
12. Matches.
13. Topics.
14. Geographical card questions, which the teacher may make herself.
15. Outlines.

APPARATUS

1. Cabinets.
2. Globe.
3. Tellurian.
4. Pictures.
5. Maps.
6. Product Charts.
7. Modeling Board.
8. Black-board.
9. Reference Library.

EMERALD LAKE AND CHANEY GLACIER, NEAR LAKE McDONALD, MONT.

THE INFLUENCE OF RAINFALL ON COMMERCIAL DEVELOPMENT: A STUDY OF THE ARID REGION *

BY JACQUES W. REDWAY, MT. VERNON, N. Y.

Fifty years ago there was one feature on maps of the United States that invariably demanded the respectful attention of any one who might unfortunately seek information concerning the topography and drainage of our possessions west of the Missouri river. This impressive feature was a vast area of territory, roughly elliptical in shape and severely definite in outline, bearing on its face the portentous name, "Great American Desert."

In time, as settlement and exploration pushed westward, the boundaries of this area, little by little, were contracted, until they finally disappeared, and the name itself was transferred to a small and indefinite territory lying west and south of Great Salt Lake—the dry bed of a former inland sea, which, at a period not greatly remote, poured its surplus waters into a tributary of the Columbia river. Thereupon it became the custom to smile at the ignorance of our cartographers whenever any allusion to our desert possessions was made, and we triumphantly pointed to the statistics of population and produce in refutation of such an absurdity. At the same time we gave with a free hand from our treasury of public lands to whomsoever that asked. Among the recipients of public bounty were, it is needless to say, railway corporations, cattle-syndicates, and land-speculating trusts. The rest was left to the bona-fide settler, with an implied understanding that he must not complain if a railway company or a land trust swooped down upon his home and holdings, after he had improved the land and made it productive. It is almost superflous to add that the cultivable prairies and the river-bottom lands were acquired mainly

* Reprinted from the Proceedings of the Engineers' Club of Philadelphia.

by the speculators and corporations. The remainder was the property of the homestead and the pre-emptor, and it is concerning this remainder that I wish to present a few facts.

It may be considered a piece of impertinence to intimate that neither the average newspaper writer nor the average reader fully comprehends the somewhat indefinite term "desert." I am inclined to believe, however, that he does not. Almost always we associate the word with a vast expanse of sand. Even the critical German geographer habitually speaks of it as a sand-waste (*sand-wüste*), and the term "sanding" is technically applied to the stipple-marks that on our maps conveniently represent desert areas. True sand, however, a form of silica, is the oxide of the non-metal silicon, and is usually a product of sea-shores. Excepting the external varnish of silica, which protects and strengthens the stalks of certain endogens, this element plays no part in biological processes or in plant economy in general. Mixed with clayey soils, it mechanically renders them more porous, and by increasing their capillarity, gives to them a greater power to hold as well as to absorb moisture. This element is not an essential, however, and a soil of pure sand is absolutely sterile.

Now if there is anything scarce in desert regions it is true sand; water is abundant in comparison. That there are vast extents of finely-divided pulverulent soil that shifts and drifts with the winds, is true. Except in rare instances, however, it is not sand. The quarternary detrital deposit covering the Colorado Desert of Southern California is an example in question. This substance passes casually for sand, and, as a matter of detail, it makes a most excellant mortar, both for masonry and interior finish. It contains a small percentage of silica, but a close examination shows it to be composed of finely-divided felspathic rock—the disintegrations of granite, syenite, and actinolite—extraordinarily rich in all the elements, water excepted, for the fullest development of plant life.

To a greater or less extent the same is practically the case of most desert areas. So far as physiographic condition is concerned, the soil of a desert may be of almost any character, detrital or sedentary, shingly or pulverulent, compact or drifting, basic, acid, or saline, in chemical structure. Moreover, topographically and physiographically, the surface may be level, undulating, or mountainous; the climate may be hot or cold, equable or extreme.

There is one essential mineral element wanting, and until this is supplied, a desert will be a desert, no matter how rich its soil. This essential is water, and its presence or absence makes practically the only distinction between fertile and barren lands. That there are localities, the soil of which is destitute of nutritive minerals, or which contains substances fatal to the existence of plant life, is true; but such areas are inconsiderable in size, and they are impartially distributed among both rainless and rainy regions.

Deserts, therefore, may be defined as regions deficient in the amount of moisture necessary to support plant life. Practically, one may make a more conventional distinction, and regard them as regions so dry that ordinary food-plants will not mature there. The belief that the soil of deserts is innutritious, has become almost traditional. Yet, as a rule, the contrary is true; it is rich, because few, if any, of its nutritious principles have been exhausted. The truth of this statement is emphasized when one recalls the few artificial oases in the Colorado and Mojave deserts. The former is a broad expanse of white, felspathic detritus, mercilessly pelted by sand-blasts and writhing under a sun so scorching that even the few species of cactus wither and turn yellow; yet at Dos Palmas, a small tract watered by an almost forgotten spring yields such a profusion of flowers and tropical fruit, that one might almost imagine it the Vale of Paradise planted beyond the reach of profane defilement, and guarded by fierce simoons.

In view, therefore, of the fact that a desert owes its characteristic conditions to a lack of water, and bearing in mind also that the rainfall of an area as large as the United States may vary from *nil* to one hundred inches or more, one might expect to find almost every possible degree of productivity; and this is the case. Plant life is far more sensitive to the vagaries of rainfall than one would naturally suspect. A difference of one or two inches in amount, or the slightest disturbance in the distribution of precipitation, may decide whether a given species will thrive or perish in a certain region. Indeed, so extremely sensitive are some well-known species of food-plants, that the distribution of precipitation unchanged, a deficiency of one inch in amount over the region cultivated would cause a measurable disturbance in the industries of that region. That is, if ten inches in amount, or a monthly distribution, is essential to perpetuate a species of grass, it will

thrive and extend its geographical limits when the annual rainfall is eleven inches; it will perish and disappear if the precipitation is reduced to nine inches, or if there be yearly a period of drought exceeding one month.

In the United States we find not only an annual precipitation, varying from practically nothing to one hundred inches, but in the matter of distribution, also, there is every variety, from a cloudburst once in two or three years, to an almost steady downpour during ten out of every twelve months, and occasional showers during the remaining two.

East of the Mississippi river there is practically no area in which, so far as moisture is concerned, grass and the cereals cannot be profitably and profusely grown. In no part is the rainfall less than thirty inches per year, and the average is nearer forty inches. If there be any cultivable part of this region, therefore, in which grass- and grain-growing is unprofitable, it is because of the high value of the land, or else its inaccessibility to a market. A high value of land is, of course, an effectual bar to grain-growing; but inasmuch as land at $1,000 per acre will commonly yield a much greater income from other products than land at $30 per acre sowed to wheat or corn, there is little or no actual loss of productivity. The Mississippi Basin is one of the most fertile regions in the world, and, if we consider its size, it is capable of producing a more valuable harvest than any other river basin on the face of the earth. And if its grain-producing power is not enough, there are the almost inexhaustible stores of coal and iron flanking it. So far as natural resources are concerned, there is no reason why this region should not become the greatest empire under the sun, for there is no other of equal size capable of supporting so large a population.

Beyond the Missouri the rainfall lessens considerably. The northern part of the Pacific slope excepted, no part of this area receives more than thirty inches of rain, and in the greater part—aggregating nearly one-fourth the area of the whole country—the annual precipitation is less than fifteen inches. For convenience we will divide this extent of area into three regions: the "Plains," the Colorado Plateau, and the Great Basin. There must also be included the inaccessible and therefore uncultivable mountain slopes; in some instances snow-covered, in others denuded of soil.

By far the most fruitful area of the three is the region com-

monly known as the "Plains." From the Missouri river westward it rises imperceptibly to a plateau, varying from 3,000 to 6,000 feet in elevation. The eastern part receives a generous supply of rain, and as far west as the ninety-sixth meridian it is all that can be desired in point of fertility. West of this meridian farming is carried on mainly in the river-bottom lands. Grain-farming on the sedentary or "bluff" soil is too uncertain in its results, and this part is given up to stock-raising. West of the ninety-ninth meridian there is but little land of any kind that may be called productive. Even along the small streams about the only crops that are produced are confined to small patches of barley, or of corn. Probably ninety-five per cent. of this area is used directly or indirectly for stock-raising, and in the past it has been so thoroly overstocked that at present, in some localities, instead of the traditional two head of cattle that an acre of land is supposed to support, an average of at least four or five acres is necessary to each head. Until recent years, scarce an acre has been seeded or cultivated; on the contrary, its surface has been so thoroly tamped and packed by the hoofs of millions of cattle, that the productive power of the soil has been greatly reduced. It is cheaper to rob the United States of the nutritive elements of the soil than to buy the land. Until recently, in the opinion of the stockmen, it was more economical to starve a herd once every seven or eight years, than to feed a smaller herd a part of every year. In other words, the average grazier was content to have the one golden egg, and bequeath to posterity the carcass of the goose. For many years the food-producing power of the plains grew less with each succeeding year. Not only was the percentage of growing grass reduced each succeeding year, because of the lessened amount of seed falling upon it, but the everlasting impact of hoofs so packed the soil that its power to receive and hold the small amount of water was also lessened. The water, therefore, instead of penetrating the ground, drained off at the surface. In the past ten years its grass-producing power has been increased by plowing and seeding, and the exercise of a long dormant horse-sense has compelled the graziers to adopt wiser and more economic methods. They learned by experience that grass once weakened in vitality, becomes the prey of noxious weeds, and the latter ultimately take its place.

The Colorado Plateau is bounded mainly by the Uinta and Wasatch mountains. The upper part of the river-basin is in a fer-

tile and well-watered region. It comprises within its area a large amount of cultivable land and some of the best stock ranges in the country. The greater part of the drainage-basin, however, consists of a succession of sandstone mesas—the bottoms of old lake-basins, that in past geological times were upheaved and synchronously dessicated. Thru this area—somewhat more than 250,000 square miles in extent—the river and its tributaries flow in cañons, varying from a few hundred to more than six thousand feet deep. The streams, therefore, are practically underground streams, and so far as supplying water for purposes of irrigation, they are of little or no actual use.

The plateaus, tho characterized by a monotony of structural detail, are vastly different in climate and physiographic aspect. Shivwits plateau, for instance, the lowest in altitude, is generally barren and desolate. The edges are frayed and notched with gulches and miniature cañons, which carry water only when some straggling rain-cloud discharges its contents on the mesa, in the form of a cloud-burst. Springs are found here and there, however, and around the vicinity of each are clustered the wickiups of the squalid Shivwits Indians, who manage to exist on the few acres of corn they cultivate. Uinkaret Plateau, one of higher altitude, is more habitable. It receives a fairly generous rainfall, and, in consequence, there is a considerable area of good grazing land, with here and there a stream flood-plain of a few square miles in extent. Kaibab plateau is the highest of the mesas. Owing to its altitude it is covered with deep snows during the winter months, and as it possesses a deep and nutritious soil, there is an abundance of grass and timber. Owing to the topography, it is not generally well suited for cultivation, but no better region can be found for summer grazing. These three mesas are fair types of the surface of the Colorado plateaus. The lowest, "sandy" and alkaline in character, are worthless for the cultivation of crops, unless the latter be of lizards and rattlesnakes. The midlands are moderately well watered, but the cultivable lands are confined to the river valleys. The highlands are cold, but productive. The lower course of the Colorado river—and of several of its tributaries as well—lies practically in a desert region that possesses no drainage to the ocean. The rainfall is scant, rarely exceeding an inch or two a year, and in many places consisting of nothing more than an occasional cloud-burst.

The Great Basin proper is a triangular-shaped area, about 225,000 square miles in extent. The northern part borders on the drainage area of Columbia and Klamath rivers. It receives sufficient rain to insure a fair yield of grain on such land as is adapted to grain-growing; but here, as in other parts of the western highlands, grain-growing must be confined to the river flood-plains. The central part of the basin is traversed by parallel ridges, the upturned edges of immense, faulted blocks, having gentle eastern and abrupt western slopes. The base of the plateau, or more correctly speaking, the floor of the basin on which these ridges rest, is from 3,000 to 5,000 feet above sea-level in its greater extent. The ridges themselves have an altitude varying from 7,000 to 11,000 feet, and are therefore capable of wringing more or less moisture from the few clouds that pass the crests of the Sierra Nevada mountains.

The northern part of the Great Basin has a rainfall sufficient, by the aid of irrigation, to make productive a few thousand square miles of land. The central part contains but little grazing and less cultivable land. The higher slopes of the ridges are grass-covered, and at their bases there are a few ephemeral streams whose flood-plains may possibly afford each a small acreage of barley-fields. The only streams of any size are Humboldt, with its tributary Reese, and Carson River. In their upper courses these streams are mountain torrents. In their lower parts, however, they carry but little water, and in very hot weather disappear altogether. A few square miles, suitable for garden or barley ranches, is the extent of the cultivable land in their basins.

The lowest and southern part of the Great Basin is irreclaimable and practically uninhabitable. Excepting the crests of the granitic ridges, there are but few parts of this region more than 1,000 or 1,500 feet above sea-level, while more than 2,000 square miles are below it. Along the western edge there are here and there a few acres of land that may be made productive by irrigation, but even these spots, rare as they are, are seldom utilized. Death Valley and the Sink of the San Felipe—the latter now better known as Salton Lake—are situated in this part of the Great Basin. The whole region is typically a desert. Cacti and yuccas are about the only forms of vegetable life, and in much of the area these are dead, and their spiked, thorny stalks and trunks are bleached to whiteness under a scorching sun whose direct rays register 130° to

145° on the thermometer. So intense is the heat in this region that evaporation from a body of water of considerable depth exceeds one hundred inches per year; in shallow pools it is nearly two-thirds of an inch a day. The Sink of San Felipe River is scarcely 600 square miles in area, yet the whole flood of the Colorado River would not fill it to the height of overflowing.

The foregoing paragraphs give a brief description of the arid lands of the United States. In round numbers this region has an area of 1,340,000 square miles, or upwards of 900,000,000 acres. This does not include all the land where crops must be irrigated; there is a belt one hundred miles or more in width, lying on both sides of the 98th meridian, in which crops may mature finely one season, and, for want of water, perish the next. But leaving this area out, we must open our eyes to the fact that one-third of the territory of the United States consists of land that cannot yield food-crops without artificial aid. Of this vast area Professor Powell estimates about 500,000,000 acres would be productive were there sufficient rainfall. The remainder consists of rock and shingly surfaces, and of slopes so rugged that their cultivation would be out of the question.

Experience has shown that an acre-foot of water—that is, the equivalent of a rainfall of twelve inches—if applied to the ground judiciously, is sufficient to insure a fair grain crop. We must bear in mind, however, that this estimate is an average rather than an actual value. In stiff, impervious soils, especially if there be considerable slope, twice that quantity of water might not suffice, while in the loamy soil of San Fernando valley, in California, six inches of rain, falling opportunely, will insure a fair yield of grain. Taking all the factors into consideration, however, the surveys of Professor Powell demonstrate that about 100,000,000 acres of the now unproductive lands of the United States may be reclaimed—an area about four times that of Pennsylvania, or nearly equal to that of Ohio, Indiana, Illinois and Iowa combined.

Now, the reclamation of these lands, which at present are practically deserts, must depend on irrigation; but the manner in which the water must be obtained may be one or more of three ways: storage of surplus waters, artesian wells, and submerged dams and sand reservoirs. Of these, by far the most important, is the storage of storm waters.

In many parts of the said region there are large areas in which

the rain is not sufficient to form permanent streams, but where the only flowing waters are those of storm streams. These may be turbulent torrents during a few months of the year, but they are dry washes during the greater part. Now, as such streams have no commercial value beyond the amount of water they contain, their contents may be impounded in reservoirs during flood seasons and measured out at times of drought. In the "plains" these stored waters will be valuable, not only on lands where the crops are uncertain, but they will be useful also to reclaim certain lands that are now unproductive. The impounding and storage of the contents of temporary or storm-water streams presents no difficulties in the way either of engineering or of legal problems. The catchment basins are small in area and they naturally localize themselves as to distribution.

In the case of larger streams, however, especially navigable waters, the problem becomes so complicated that nothing short of national legislation will be able to settle the conflict of State and private claims. For instance, a large part of the arid belt of Kansas will always be dependent on the waters of the Arkansas river for irrigation, but the only places where storage reservoirs can be constructed are high in the mountains in Colorado. That is, the Kansas farmer is as much interested in the proposed reservoirs at Twin Lakes as the Colorado farmer. Let us suppose that these reservoirs are constructed and the gates are closed for storage. This at once lowers the level of the stream, and cuts off the supply of water taken by a multitude of small ditches, whose head-gates are scattered along the river in the eastern part of Colorado. Now, inasmuch as the latter are prior rights, the courts of Colorado would sustain them, even tho both parties to the suit were resident in Colorado--most certainly would they sustain them against the claims of the citizens of another state. Altho the case mentioned is hypothetical, one such has already arisen. Some years ago the state of Nevada appropriated a large sum of money for the construction of storage reservoirs on Truckee river, the same being designed for the reclamation of land capable of a high degree of cultivation. After the surveys had been made, it was found not only that the reservoirs must be located in California, but that the authorities of that state were ready to enjoin the construction of any scheme that would involve a change of water-level in California territory. The plans were, therefore, abandoned. There is

another serious obstacle in the way of impoundment of storm waters, that may also be felt at a future time. Suppose that the storage of waters becomes so general that the navigation of any river, now classed as a navigable stream, is obstructed. It is hardly necessary to discuss what the final result would be. Or, were the storage of waters to affect the free navigation of a river like the lower Colorado, whose mouth, constructively, is in a foreign country; is there any doubt about the outcome of the question? But the Colorado is not the only river presenting an international question; the Rio Grande, the Columbia, and half a score of smaller streams possess each a wider field for conflict. In fact, there is not a river of magnitude in the arid region that may not bring about either interstate or international complications.

There are, also, a number of difficult problems that are purely local to each of certain drainage areas. I take for illustration the drainage territory of the Rio Grande below White Rock Cañon. From the mouth of the cañon there are rich, reclaimable lands for a distance of nearly 200 miles below, unfortunately more than can be irrigated. Now, in the northern part of this area the river will afford irrigation for two acres to every one in the southern part. But at the present time the greater part of the cultivated land is in the southern end of the valley, and either their rights should be maintained or else equity should be the basis of their extinguishment. These conditions have already led to long-continued litigations, and in several instances shotgun injunctions have demonstrated that the people are mightier than the law.

Such complications cannot be wholly prevented, but their occurrence can be largely obviated. Their number will be reduced to its minimum only when the catchment basin of each stream, no matter whether in one state or a dozen, is under the control of the land-owners of that particular district. The water and the land must go together, and no water-owning corporations or companies should be permitted to exist under conditions by which the land-owner may be subjected to a corporation's cinch. Irrigable lands are dependent upon catchment areas where forests and grass are most abundant, and storage reservoirs must, therefore, be constructed, not on the irrigable lands, but high in the mountains; and. to get the full value of the waters, the lands themselves must be selected as near as possible to the reservoirs. Pasture and timber lands should be permanently reserved, and all reservoir sites,

canal sites, and head-water sites should be placed under the control of the general government.

And here let us consider the question of artesian wells. No more water can be obtained from an artesian basin than is supplied to it; it is equally true that the number of wells in a given artesian reservoir is limited. A well discharging a cubic foot of water per second may afford sufficient water to irrigate two hundred acres; in the fruit ranches of Southern California it will supply the amount required by about seventy-five. Now if there were an artesian district that would furnish, from flowing wells, a second foot of water for every 200 acres, the problem of irrigating the arid lands would be an easy one. There would be no need of the 150 reservoir sites and irrigation districts the United States Irrigation Survey has located. It would not be necessary to impound a gallon of water, nor construct a yard of canal. But, unfortunately, not all artesian wells are flowing wells, nor do all the flowing wells yield an average of a second-foot of water; on the contrary, they yield but a small fraction of it. Furthermore, tho the first wells driven in a district may be spouters, the driving of additional wells quickly reduces the pressure; the flow from the first wells diminishes little by little; the water-head is soon lost; and water must thereafter be obtained by pumping. So, instead of the seventy-five acres which the theoretical second-foot well is supposed to irrigate, the actual value is nearer five. In Southern California, in several instances, efforts have been made to force the yield of wells by means of powerful pumping machinery; but no matter how powerful the pump, water cannot be drawn into the induction pipe faster than the sand and gravel yield it. Moreover, if all the artesian wells used for irrigation thruout the whole world were assembled in a desert region the size of the state of Delaware, they would not supply it with the amount of water required to irrigate it. This statement seems pretty strong, but the statistics gathered by the Irrigation Survey bear it out. In Algeria 4,000 acres have been reclaimed by irrigation. In Southern California State Engineer Hall affirms that less than 3,000 acres have been made productive by irrigation. This, moreover, exceeds the acreage of all the other states and territories combined. And the moral is plain; artesian wells will afford only an infinitesimal part of the water required for irrigation.

There remain only the sand reservoirs and submerged dams to consider. The former present no problems essentially different from the catchment reservoir of an artesian district. The chief feature is the fact that a cubic foot of sand, saturated with the water it will hold by capillary attraction, becomes no inconsiderable reservoir when the number of cubic feet are multiplied. Unfortunately, the number of sand-valleys and basins is small, and their aggregate area inconsiderable. The submerged dam has even a more limited application, and so far has been employed mainly in Southern California. Here there are many hondas, or narrow cañons, opening like immense crevasses into the mountain-ridges that rise abrubtly from a recently-formed coast plain. The mouth of each is filled to a depth of many feet with coarse talus—the products of stream-corrasion. A stream, great or small, according to the season, flows on the surface of the talus. Beyond the mouth of the cañon it may flow onward to the sea, or it may be entirely lost in the sandy soil of the coast plain. Now, altho the amount of water flowing in the stream-bed proper is great, that which sinks into the ground and finds its way along the sloping bedrock is still greater. If now a concrete dam be built across the mouth of the cañon, from bedrock to a few feet of the surface of the talus, all this seepage or underground water can be impounded and utilized. Thus the submerged dams do not differ in application from the storage reservoirs. In Southern California there is an obstacle in the way that in most localities will prevent their general use. The seepage water, thus impounded, is the water that supplies artesian and all other wells; and inasmuch as most of the water that flows out into the coast-plain thru these cañons is cut off by the submerged dam, litigation has resulted in their disuse.

In the foregoing pages only the salient facts concerning the reclaimable arid lands have been given. These, however, are sufficient to demonstrate that the expense of reclamation is too great, and attended with too many legal complications to be undertaken by any other than Government authority. Even after water has been supplied to each reclaimable acre, the expense of application will materially enhance the cost of the crop. An acre of wheat, irrigated by artificial means, cannot well compete with one watered by rains. Not only are the arid lands deficient in natural waterways, by which crops are removed at the minimum of expense, but

because of the lessened amount of product, railway tariffs must of necessity be greater. Furthermore, the cultivable areas being distant from one another, and therefore from a market, the matter of distance will materially increase the cost of transportation. Owing to the abnormal increase of the population of the world, the value of food-producing lands is constantly increasing. When, therefore, the value of the grain-producing area of the United States has increased to an extent that the taxes absorb the greater part of the profit, food-crops will naturally seek the reclaimable lands of the arid region.

Because the area that is naturally irreclaimable is so great, it is evident that the western highlands of the United States will always be sparsely populated, and, compared with the Mississippi Valley, will support only a small fraction of the number per square mile that the latter will maintain. Its vast mineral wealth, however, will go a long way to make up for its food-producing deficiencies; and the development of its agricultural features will follow rather than precede that of its mineral wealth. The climatic conditions, humidity excepted, are generally favorable. Everything that can be cultivated between the latitude of Northern Norway and Southern Egypt can be grown in this region. Cotton, maize, wheat, barley, oranges, lemons, grapes, bananas and pineapples are among the facts; the possibilities are far greater.

THE GROSS TOPOGRAPHY OF THE GLOBE

BY GEO. L. COLLIE, BELOIT COLLEGE, WIS.

Under this head are included all of the great physiographic features of the globe, such as the continental blocks and the sea basins. A thoro discussion of this subject involves an investigation into the origin of these gross features, and that origin is in turn closely connected with the question of the world's origin. The way in which the world was formed and the methods of contraction that followed, determined in large measure what the character, shape and size of the continents and ocean basins should be. Interesting as an investigation into the origin of the earth might be, it is confessedly too difficult for high school pupils to enter upon. It is better to take all of the preliminaries in connection with the earth's origin and subsequent history for granted, and to study the present characteristics of the gross topography. A glance at the globe reveals two great natural features, land and water surfaces. The land, areally, is much less than the water, but if we consider the cubical contents of the globe, the solid exceeds the liquid in the ratio of 199 to 1. There are 258,509,000,000 cubic kilometers in the globe; one-half of one per cent. or 1,292,-500,000 cubic kilometers is water.

The continents and the ocean basins are extremely old features, by far the oldest topographical features on the globe. The sea basins and the continents arose from differential contraction of the crust, which took place in such a way that the surface sank more rapidly in some localities than in others, and so became more depressed; as a result, the depressed regions became occupied by water. The continents are not rising regions and the ocean basins sinking regions; all portions of the globe are contracting, but the ocean basins contract more rapidly than the continents. This more rapid contraction may often result in a deepening of the basin and the consequent withdrawal of the water from the land,

producing the appearance of continental uplift, even tho the continent has been contracting all of the time. Because of the greater compression in sea basins the crust is more dense there than elsewhere; for this reason the mobile waters of the ocean are drawn toward the locality of greatest density, and are drawn into and held in the basin, not alone because it is a basin but also because of the superior attraction of the crust under the basin. The basin of the South Pacific is not only the largest in the world but the crust there is the densest, and for this twofold reason it contains the largest water area in the world. The land mass of the continents also attracts the water to some extent and draws it up over the land surface. Thus where a great mountain range, like the Andes, lies close to the sea, the attraction of the land mass is sufficient to draw the water of the Pacific over the lower portion of the continent for quite a distance. If the Andes could be removed it would be found that the waters of the ocean would retreat from the present shore-line of the continent, in some cases for a distance of several miles, and the present seaports would be left in the interior. It follows from the above statement that the present shore-line does not necessarily represent the true boundary between the continent and the sea.

The Continental Shelf.—It is customary among geographers to refer the edge of the continent to the edge of the continental shelf, which is approximately identical with the one hundred fathom line. The surface of the oceans cover a much larger portion of the globe than the land, in the ratio of 72.3 to 27.7. Not only does the sea cover a larger area, but it is on the average much deeper than the average altitude of the land. The mean depth of the sea is approximately 14,000 feet, the mean elevation of the land about 2,400 feet. Over one-half of the whole surface of the globe lies below a depth of 10,000 feet, and two-thirds of the surface lies below the one hundred fathom line; one-third of the surface lies above this line, and this one-third is generally regarded as continent whether it lies above or below the water. It has been found by the soundings that the ocean is shallow for some distance out to sea, and that the bottom in these shallow portions is very much like the land surface in its contours and topography. In so marked a manner is this true that it seems best to consider this shallow portion, continental shelf, as it is called, a part of the continent. In many instances it is possible to prove that the shelf

has been a part of the land surface in actuality; sub-marine channels are found which are in some cases a continuation of land streams, showing that rivers have once flowed over the area. The general topography also is like that of the land surface but totally unlike that of the deep sea bottom. The continental shelf is formed in two ways. It is in part a base plain, cut by wave action; in large part it is, however, formed by the washing of debris from the continents into the sea and there distributed by the waves and currents. The reason why the shelf coincides so closely with the one hundred fathom line is because it is at this depth, on the average, that the water ceases to carry and assort land debris on the sea bottom; hence the shelf ceases to be formed at that line, and slopes off by a sharp declivity to the greater ocean depths. Professor Chamberlin has applied the name, circum-continental terrace, to this portion of the continental shelf. The shelf has been an exceedingly important factor in past geologic ages, since it has been the chief theatre of oceanic life, from which life has proceeded landward and also seaward into the greater depths of the ocean.

From the economic standpoint the shelf is still extremely important on account of its fisheries. The continental shelf varies greatly in width; sometimes it is wide, as off the eastern coast of the United States, where it reaches a width of one hundred miles or more. It is apt to be thus wide where the coast is low and the slopes gentle. Sometimes the shelf is narrow, as off the coast of California, in such cases the coast is steep and rugged, as a rule. Great Britain is on a shelf of this kind and so is really a part of the continent of Europe; in like manner New Guinea is a part of Australia, since it stands on a shelf uniting it with that continental island. The East Indies are a part of the Asiatic continent for a similar reason.

Since the continental shelf is a part of the continent rather than of the sea basin, it is well to give a different designation to that part of the ocean that lies upon the shelf. That part of the ocean is called the epicontinental sea, because it lies on the continent. The part of the Atlantic ocean, for instance, which lies on the Grand Banks of Newfoundland is epicontinental. The epicontinental seas differ from the ocean proper, in many respects; they carry a larger amount of material in suspension, they are shallow, and these two facts in conjunction make the water a light green

color very different from the blue of the deep sea. The life on the shelf is quite different from that in the greater depths of the sea. In addition to the epicontinental sea there is another type of sea found close to the continents, which deserves mention. This is the ingression sea or "Mediterranean" as it is called by Professor Davis. In the mediterranean seas the continental block surrounds partially or almost wholly a sea which is located in a deep depression or basin within the block. They differ from the epicontinental seas in being placed within basins and not lying on smooth constructional plains. The Caribbean sea is a good example of this type of sea.

Continental Blocks and Ocean Basins.—One of the noticeable features of land and water distribution on the globe is that the continents are separated from one another in whole or in part while the oceans are connected. Ancient people understood little about the relative proportion of land and water and still less of their relationships. There were two schools, which differed materially in their views respecting these relations. The Homeric school taught that the land lay island like in the midst of the ocean. Aristotle and Ptolemy held the opposite view that the land surface was much the greater in extent, and that it surrounded the ocean on every side. Up to the time of Columbus it was believed that six-sevenths of the earth's surface was land. Cook by his explorations (1768–1779) finally confirmed the true view of the proportion of land and water and the relationship of continent and ocean.

If the oceans should be withdrawn from their basins, the continents would appear as relatively small plateaus surrounded by a somewhat featureless plain. The land mass is largely in the northern hemisphere; this is more apparent if we take the latitude of the three most prominent capes at the southern end of the continents, and refer it to the northern hemisphere. Cape Horn is in latitude 56° S., corresponding to the latitude of Edinburgh; the Cape of Good Hope is in latitude 34° 51′ S., corresponding to the latitude of southern Tennessee; while Tasmania may be compared with Boston. In a gross way the continents have features in common, but in detail they are very different, and these differences increase with the passage of time. Each continent has different earth movements affecting it; glaciation and vulcanism are different, climates differ, and these all have the effect of increasing

the local and detailed features of the continents. A few features are more or less common to the continents; for instance, the broader portions are to the north and taper to the south, cut off as it were by the meeting of the predominant northeast-southwest and northwest-southeast cleavage planes of the earth.

The oceans have the reverse contour, and taper to the north; on the whole, the combination of northward tapering seas and southward tapering lands produces the interlocking arrangement of continent and sea. Another feature is the zig-zag relationship of the northern and southern continents, exemplified especially in the case of North and South America, Asia and Australia. The prevailing trend of the continents, as already indicated, is northeasterly or northwesterly. Variations from these trends are along curving lines as seen in the trend of the West Indies from the United States toward South America, or in the case of the East Indies. The arrangement of the minor topography of continents shows more or less system, such as their elevated borders and basin-like interiors, and the highest border facing the largest ocean.

In the sea bottom the greatest depths are not in the central part, but to one side near the continents. There is also a greater mean depth in the western half of oceans than in the eastern half. A great many theories have been advanced to explain these similarities of arrangement in continents and sea basins, but nothing that really holds water has been advanced. It is doubtful at this late date in the world's history, whether anything can be worked out which will satisfactorily explain the characteristics of continents and sea basins. The problem is much complicated by the fact that in many major and minor details the continents do not conform to any standard and so cannot be reduced to equations that can be compared.

As has been stated above, the surface of the continent may be said to end at the one hundred fathom line, from which line the sea bottom shelves off rapidly toward the abyssal depths. If the one hundred fathom line is the edge of the continent, where does the foundation begin? Where on this long slope is the division between continental block and sea basin proper? The isobath of ten thousand feet may be taken as the dividing line. All portions above this depth belong to the continental block, or 46.7 per cent. of the total surface of the earth. All below this depth belongs to the deep sea region, or 53.3 per cent. of the surface. If the

continents and sea basins are thus delimited, the earth's surface is about equally divided between them. If we accept the isobath of 10,000 feet as the dividing line, it is quite safe to say that the continents and sea basins are permanent features, and have never changed places. This is not saying that the continents have not been covered in whole or in part by epicontinental seas, for they have been thus covered. But at no time in their history have the continents been a part of the abyssal depths of the ocean; continent and sea basin has held each its own position and its own peculiar outlines from early periods. That continent and sea basin have held their relative positions is indicated by the character of the deposits in each. The deposits of the deep sea bottom are very unlike those found in shallow water, or such as make up the clastic rocks that surface the continents in large part. In the deep sea the deposit accumulates with exceeding slowness, and is made up for the most part of minute tests of plants and animals, which accumulate and form a soft fine ooze. On the other hand the materials which form in shallow water are comparatively coarse grained, such as gravel, sand, and mud, containing relatively little organic matter. This kind of deposit accumulates rapidly; and it is this kind of material, cemented into compact form such as shales and sandstones, which makes up the larger part of the continental surface. It follows then from what has been said that this surface was never in the abyss of the sea, for the ooze-like deposits do not form surface rocks, at least to no great extent. The question now naturally arises how wide spread are the changes that have taken place? If sea and continent have never changed places, how far have they invaded each other's domain ? Such a question cannot be accurately answered. There have been many changes, and the continental surface has had other outlines than those it now has; but the foundations of the continent have not changed their outline to any great extent. Usually the changes on the surface have been in the neighborhood of the seacoast, tho time and time again the epicontinental sea has pushed its way far into the continent and even extended across it. Alternations between land and water are common in geological history. They have made great changes in a superficial sense upon the earth; but we may press the point again that it has been only superficial. The amount of change, that has thus taken place between land and water, has been worked out in a number of ways. Among the methods used are the fol-

lowing: the present distribution of sea shores that have been raised above sea level; the character of the sea bottom; the distribution of islands; the migration of animal life, especially land life in past ages—for instance mammals cannot pass from one continent to another if they are separated by water, since they need land connections in order to pass from one to the other. All of the methods cited above have been used to determine the former relationship of land and water. By using some one or all of these methods it seems probable that in the following cases, in modern geological time, land areas existed where the sea now stands: North America was connected with Asia by land across Bering Strait; Africa was connected with Madagascar; Australia with South America and also with Asia; North America extended one hundred miles further east in many localities than at present; and Great Britain was connected with the continent of Europe. Other cases might be cited but these suffice to indicate some of the more important of the surface changes.

Topography of Sea Basin and Continent.—If we were permitted to visit the sea bottom we would find a topography there very different from that to which we are accustomed on the land. The topography is very uniform, since erosion by stream action and thru other agencies does not work there. None of the results of erosion such as valleys, steep cliffs or other sharp declivities are found except in the neighborhood of land. The sea bottom extends for great distances in long gently sloping undulations. Differences of elevations on the sea floor are greater than on the land surface, but the slopes are much more gentle and the topography there is for that reason smoother and more plain like, the chief characteristic of the sea bottom being the basin like plain. Great plateaus exist in the ocean basins, but they do not as a rule rise abrutly from the general plain. Some of these plateaus rise to within a few hundred fathoms of the surface; in such cases they are often occupied by volcanic islands and by accumulations of organic debris. Thru the basin of the Atlantic there passes a plateau from north to south repeating in its form the S-shaped contour of the basin.

In contrast to the plateaus there are great depressions in the ocean, basin-like in character. It is rare to find depressions exceeding three thousand fathoms in the Atlantic, tho much greater depths are found in the Pacific. Depressions which exceed three

thousand fathoms in depth, are called "deeps," and special names are applied to them, such as the Tuscarora deep. At the present time something like forty-four of these deeps are known, of which number twenty-five are found in the Pacific, fifteen in the Atlantic, three in the Indian ocean, and one in the Southern ocean. Several of these deeps exceed four thousand fathoms in depth, and four of them exceed five thousand fathoms. The deepest deep known was recently found by the United States steamer Nero in its survey for a transpacific cable. The deep is located near Guam Island and is 5,269 fathoms, or 31,614 feet. Another deep just east of the Friendly Islands is 5,155 fathoms, a measurement which exceeds the height of the loftiest mountain on the earth by two thousand feet. In these great depths the water is but little above the freezing point, total darkness exists everywhere, and vegetation is almost wholly absent. The ocean bottom is a cold, dark floor covered with slimy ooze and the remains of dead organisms. The continents have a much more diverse topography than the sea bottoms, because of the greater variety of agencies that work upon the lands. Mountain ranges are the greatest of these minor features, yet they are a small part of the bulk of the continent. The Alps, if spread out over the whole of Europe, would raise the surface of the country only twenty-two feet. Minor topography is better treated by itself than in connection with the great features of the world. Islands, both oceanic and continental, may be treated in connection with the continents and ocean basins. The oceanic islands are relatively unimportant, tho their origins are interesting; continental islands, too, are so closely connected with continental history that they do not need separate treatment. In most cases, they have recently been a part of the continent and have been separated by drowning of the intervening lands, or the tides have scoured out channels between the islands and the main land, and these channels have increased with the passage of time, until the islands may be separated far from the parent land mass. In a general way it is sufficient to treat of continental blocks and ocean basins when studying the gross topography of the globe, and to regard these alone as worthy of study under this head.

THE PHYSIOGRAPHIC FEATURES OF MARYLAND: THE COASTAL PLAIN

(Continued from page 137)

BY CLEVELAND ABBE, JR., ROCK HILL, S. C.

Origin.—The materials worn from the Piedmont Plateau during its later topographic development, were carried by the streams of the state into the Atlantic; and accumulating there built up a broad, flat-topped platform bordering on the shore and lying but a few hundred feet below sea-level. This submerged platform was a part of the more extensive continental shelf which was being built, during the same geological epochs, along the whole Atlantic coast of North America. Its construction seems not to have been continuous, for there are discontinuities and unconformities within its mass of almost horizontal strata, indicating that at times a portion of the shelf stood above sea-level and suffered from marine and subaerial erosion. In brief, this shelf would seem to indicate that the Atlantic coast has been alternately up and down several times during its recent geological history.

The greatest of its recent movements has been an upward one, which served to raise about one-half of the shelf above sea-level. Thus the eastern portion of Maryland is now a comparatively smooth, even, sandy or clayey plain, which has recently formed the sea floor just beyond the former shores of the Atlantic, and which may yet be traced from its dry land portion continuously to and beneath the sea for many miles. Because of its nearness to the coast, of its mild topography, and of its geological history and origin, this lowlying sandy district in eastern Maryland is called the Coastal Plain.

Boundaries and Subdivisions.—As usually referred to, the Coastal Plain is said to extend from the shores of the Atlantic on the east to the Fall Line on the west. It is evident, however, that

if we consider the Coastal Plain as a geologic as well as a topographic unit,—and this we have a right to do when we bear in mind their close genetic relation—then we must include within the term Coastal Plain not only that portion of the former continental shelf which is now dry land, but also that portion which remains submerged as the present continental shelf. This paper will therefore include within the province of the Coastal Plain both that portion of the former continental shelf which has become dry land and that portion which remains submerged and extends out to about the 100-fathom line as the present continental shelf.

The western boundary proper is an irregularly waving or crenulate line, marking the western limit of the weakly coherent beds of the Coastal Plain series where they finally disappear and reveal the more resistant crystalline rocks of the Piedmont Plateau district. As will be seen by reference to the map, this line has the general direction and position of the railroad lines between Washington, Baltimore, Havre de Grace, Wilmington, Del., etc., and is thus also closely coincident with the Fall Line.

Besides the general and obvious subdivision of the Coastal Plain province into an emerged and a submerged portion, topographic features and popular usage make desirable the further subdivision of the emerged portion which is divided by Chesapeake Bay into the Eastern Shore and the Western Shore, or, as the latter is sometimes called, the peninsula of Southern Maryland. The Eastern Shore lies between Chesapeake Bay and the Atlantic, while the Western Shore is embraced between the Potomac and the Fall Line on the west and the western shores of Chesapeake Bay on the east.

Topographic Features and their Development.—When the almost even surface of the continental shelf gradually emerged from beneath the sea and became a portion of the dry lands, its topography became the topography of the young Coastal Plain then just born. What this topography was, we can best judge by studying the present topography of the still submerged part as it is revealed by the soundings on the U. S. Coast and Geodetic Survey Charts of this region. These charts show that at present the surface of the continental shelf slopes gradually seaward and has practically no marked elevations or depressions. Near the coast the waves and currents have built up a long narrow ridge of

sand behind which are the shallow tideless lagoons of Sinepuxent and Chincoteague bays; and just off the shore from this long sandy beach low swells or bars have also been thrown up almost to the level of low tide. With these exceptions however, the present submerged portion of the province is quite featureless.

Judging from this inspection of the Coast Survey Charts, then, the original surface of the emerged Coastal Plain must have been quite as monotonous; the extensive areas of original surface still remaining on the Eastern Shore, when combined in fancy with the numerous remnants found within the bounds of the Western Shore, all bear out this conclusion. In fact the Eastern Shore of Maryland is a low flat region of very even surface attaining its maximum elevation, about one hundred feet, in its extreme northern portion, and descending gradually southward quite to sea-level before the southern end of the peninsula is reached. The main divide, running almost north and south, is located nearer the Atlantic than the Chesapeake Bay shore of the peninsula. The reason for this unsymmetrical location has not yet been found, but it seems to be in some way related to the location and origin of Chesapeake Bay. The divide is broad and flat, particularly where it embraces large swamps.

The streams of the Eastern Shore all show two parts to their courses: the upper portion lying above sea-level and into which the tide never comes, and the lower tidal or estuarine portion bordering either the Chesapeake or the Coastal lagoons. Short and insignificant as are the eastward flowing streams of the peninsula, they still show this two-part character. In their upper courses all the streams show small volumes of water flowing thru rather shallow and open valleys. As the streams draw nearer tide water, the valley slopes usually become slightly steeper while the valley floor broadens and flattens a little. Beyond the limits of tide water, the channels and valleys do not appear to be so markedly meandering; but as soon as the valleys become subject to the daily tide, being half filled and half emptied every day, the crooked character of the stream courses is clearly brought out. All these lower courses are characterized by broad tidal flats of varying widths confined by steep banks which often show wave and tide-cut cliffs twenty to forty feet in height.

As is to be expected, there are no well marked sea-cliffs or wave-cut cliffs on the bay side of the Eastern Shore, for its shores

are as a rule too low. On the contrary, the mouths of the tidal estuaries frequently become confused in the maze of low-lying and swampy or boggy islands which fringe this side of the peninsula. These islands are gradually wearing away under the slow attack of the relatively weak waves sent against them; and the brackish waters of the bay are gradually finding their way to the roots of the pines growing on many of these islands, with the result that many trees are dying. The whole character of topography and stream-courses on the Eastern Shore is thus seen to suggest that, after being elevated sufficiently to permit the streams to carve, or rather to begin to carve, a very mild topography, the district was then partially submerged so that the tide now runs far inland from the Chesapeake Bay side, but only for a short distance on the Atlantic side.

Crossing Chesapeake Bay to the Western Shore, or the peninsula of Southern Maryland, there is a decided change in topography and in shore-line characters. The original surface of the Coastal Plain has here been raised much higher above sea-level, the average elevation being about three hundred feet for the inter-stream areas. By reason of this greater elevation, the streams of this district have been, and still are, able to cut their valleys much deeper than are the streams of the Eastern Shore. It is not surprising, therefore, to find that the original surface is now much cut up into long flat-topped ridges and small table-lands forming rather immature divides between valleys which are, in some cases, wide and alluvially floored, but always steep-sided, even when they are not bounded by steep cliffs as is the case in the lower portions of most of them.

In some cases these flat-topped divides are the resting places for the rain that falls upon them, as is clearly shown by small, boggy sections which may be found on inter-stream areas not very far from Washington city, D. C. In certain instances, notably that of divides for streams running into the Potomac on the one hand and the Patuxent on the other, the divides do not hold their well-marked and sharp crests evenly balanced between the two main streams, but have pushed over farther to one side than the other. In the instance mentioned, the crest-line stands nearer the Patuxent than the Potomac. This lack of symmetry in location of divides has yet to be satisfactorily explained. In some instances it may be due to local tilting; in another instance it certainly can

be explained, in part, by the erosion of the waves in the bay wearing back the cliffs more rapidly than the streams on the western side of the little peninsula have been able to wear down their upper valleys.

All the valleys of the Western Shore, which belong to streams of any size, present along their lower courses in particular good illustrations of river terraces. Most of the streams show two sets of terraces, and so far as the study has been carried, it would appear that, in the case of those streams which flow from the Piedmont Plateau out across the Coastal Plain, these two terraces can be correlated with more fragmentary ones found along the Piedmont portion of these valleys. The terraces in the Coastal Plain province are regarded as indices of the depths to which the rivers were submerged during a partial subsidence, which seems to have occurred after the last great emergence gave opportunity for the streams to carve out valleys of considerable depth in the yielding Coastal Plain strata. These subsidences, succeeded by emergence and further cutting, as the terraces indicate, have finally been followed by depressions of less amount, which have partially drowned the lower courses of the rivers, admitting tide water as far inland as the Fall Line. Since this final subsidence, the smaller streams of the Western Shore have shown a distinct tendency to shoal their lower courses during the past one hundred and fifty years. This may indicate another earth movement in an upward direction, or it may simply mean that in spite of continued subsidence the supply of debris by the streams is too great for the weak tidal currents of the smaller creeks to carry away. Altho the amount of debris brought into those creeks now filling up, seems to be rather small, it may be that the latter is the true explanation of the phenomenon.

In concluding the chapter on the Coastal Plain, some space should be given to the origin of Chesapeake Bay, and the reason for the Fall Line. As the young marine plain gradually emerged from the Atlantic and became the "emerged Coastal Plain," those streams which had originally emptied from the Piedmont and Appalachian districts into the Atlantic farther westward, were constrained to extend their lower courses carrying them out gradually as the new forming land grew wider and wider. At the same time the rains falling upon the new land, and finding it to possess a nearly uniform seaward slope, were gathered into new streams, which headed altogether within the limits of the Coastal Plain and

flowed across it to the new shore-line. To that class of rivers which merely extended their lower courses across the new land, following down its steepest slopes, seaward, belong the Susquehanna, the Delaware, the Potomac, perhaps the Patuxent, and the Gunpowder. All the streams of the Eastern Shore belong to what we may style the new or original streams to distinguish them from the old extended streams of the first class. Both classes of streams, in following consequent courses upon the mildly sloping new land surface, were probably easily influenced by slight irregularities of surface, and also by any decided coast-wise currents which may have existed.

Both the Susquehanna and the Potomac follow courses which suggest that they met some kind of barrier, some deflecting force which turned them southward for a long distance before they could regain their normally southeastward courses to the Atlantic. Some have suggested that this deflection was due to a strong southwesterly current setting along the coast, which built along it parallel off-shore beaches and bars, such as characterize the present coast, and thus compelled these large streams to turn parallel to the coast for some distance. Another suggestion is that the last great elevation of the Coastal Plain broke it into two blocks which tilted towards each other, causing a trough where Chesapeake Bay now is, along which both streams had to run before breaking out to the eastward. The present state of our knowledge of those Coastal Plain strata which hold the key to this question, does not permit of a definite conclusion being given for Maryland. It is clear, however, that the Susquehanna did not succeed in carrying its course across the emerging sea floor in the shortest path, but was turned southward. In this anomalous path it cut a deep valley and developed some fair-sized tributaries on either side of it. Recent submergences, above referred to, have drowned the Susquehanna up to Havre de Grace. So has come into existence the long, comparatively narrow and shallow Chesapeake Bay, bounded on the west by tall, wave-cut cliffs, where the waves of northeast storms get full play against the land, while on the east or lee-shore are low-lying islands and intricate creeks with low tongues of land between them.

To return to the extended and the original Coastal Plain rivers. As these streams cut their valleys down thru the rising wedge of Coastal Plain sediments, they found that all portions of their

courses were not similarly situated as concerned the amount of work they had to do. The far down stream courses found that they soon could cut their way down to their base-level, the level of the Atlantic, and that when they had done so, the yielding Coastal Plain strata still lay beneath, and on either side of them. So they were able to wear their channels to a very low slope, or grade, in a short time, and then began to swing about from one side to the other gradually widening the valleys. Far up-stream, however, these same streams found that they had to cut thru resistant, Piedmont, crystalline rocks beneath the yielding Coastal Plain strata, long before they succeeded in reducing these portions of their channels to sea-level. Indeed, this they have not yet done, as is shown by the falls and rapids in their channels. These upper portions of their channel profiles are still steep as compared with the lower stretches of the same streams. The transition from the low, gentle grade of the down-stream channel to the steeper, rocky, up-stream grade is very sharp. The point where it is made is always recognizable as that point below which there are no falls or rapids, above which the channel is full of them. This transition point is also the head of navigation on the stream. If these points of change in grade, determined for each river, were all connected, we should find the line thus drawn would be a very safe guide for finding that transition point on any intermediate stream which might not have been used in determining the line. That line is then called the Fall Line, since every stream crossing that line changes the character of its channel from a smooth, even path below, to a series of falls or rapids, above.

(To be Continued.)

HAITI

BY W. F. POWELL, UNITED STATES MINISTER TO HAITI

The island of Haiti, up to a very recent period, was as little known to the world at large as the interior of China is to-day. Our teachers in primary and grammar schools, and even those of the high school, have given but little attention to that group of islands which encloses the Gulf of Mexico and the Caribbean Sea. Yet no part of the Western Continent is of greater historic interest than this group of which we know so little. Then too, within the last few years, the course of events has directed attention to Cuba and our newly acquired possession, Porto Rico. Little is known of Haiti except that it is one of the Great Antilles, and is peopled by the black race. Of the island proper, its topography, soil, climate, products, people, or its past history,—upon each of these subjects all our school text-books are silent; and the teachers are unable to impart this instruction as they have had no means to obtain it aside from reading brief statements occasionally found in some of our monthly magazines. These articles are usually written by men who have made only a short visit to the republic; and their impressions, not often very flattering, are readily accepted in the absence of facts to disprove them.

This island was among the first discovered; San Salvador on the twelfth of October, Cuba on the twenty-seventh of that month, and Haiti on the sixth of December of the same year. It was here that Columbus made the first permanent settlement of a Spanish colony. At the eastern end of the island, now in the Republic of Santo Domingo, stands the old residence of his son, Diego, still in a fair state of preservation. There, also, can be seen at the present day, the walled town; and many of the old houses erected by the early Spaniards, over four hundred years ago, are still in use. I would like to describe this section of the island more fully, if time permitted, but shall confine myself to the section known to us as Haiti, which comprises a third of the whole island.

Haiti is more mountainous than its neighboring republic. The principal range, called the Cibao, extends from Cape Engaño in a northwesterly direction to the Mole St. Nicholas. On each side of this axial range are several minor ranges running parallel with it. Some of these mountains are from seven thousand feet to nine thousand feet high, are clothed from base to summit with verdure, and enclose rich and fertile valleys. This section of the

NATURAL SCENERY, HAITI.

island is also well watered by mountain streams, much more so than the eastern section. Here one can see vast forests, some of which have never been visited by man, and which abound with every variety of wood that would be useful for building purposes, for the cabinet maker's use, for shipbuilding, and for the arts in dyeing and tanning. For building purposes, this section furnishes magnificent pines; an oak that is almost indestructible, as hard as

that of Europe, and impervious to worms; for joint work, a species of whitewood; for pile work, the acacia; for shipbuilding, the oak; for cabinet-making, lancewood, lignum-vitæ, ebony, mahogany of every variety, red and yellow satinwoods, several species of walnut, orangewood, and rosewood, all of which are susceptible of receiving a high polish. In the line of dyewoods, the logwood stands first in almost inexhaustible quantity; this wood yields an extract which is largely used in dyeing blue, brown, and black. Among the other principal dyewoods are satinwood, which furnishes a yellow dye; Brazilwood, a carmine dye; and fustic, a wood yielding a yellow coloring-matter, but chiefly used in combination with other materials to produce differently colored dyes. This list of valuable woods could be extended indefinitely, but these few will suffice.

Haiti unlike her sister islands has a fauna and flora distinctly her own. When first discovered, the Spaniards found but one species of wild animals, the agouti, an inoffensive animal about the size of the rabbit. In the reptilian class, there are none that are venomous; only a few snakes are to be seen, the most beautiful being the magdalene. The insect life, as in all tropical countries, is unlimited. The flying roach, from an inch to two inches in length, is the bane of the housewife. They devour everything they come in contact with, whether it be food, or linen or woolen goods. The ants are also very destructive; only the hardest of the native woods are capable of withstanding their assaults. They are particularly destructive to all kinds of furniture, except it be made of the hardest woods; mahogany, walnut, and a species of oak, are about the only woods they will not enter. Mosquitoes are also plentiful and make themselves heard and felt, but they are not quite as bad as those we find in the states. Wild bees are numerous, and from their wax and honey the government derives considerable revenue. Of poisonous insects there are but few, and the bite of none of them is dangerous.

In medicinal plants, Haiti is particularly rich. Here can be found all that is needed by the pharmacist; and what is brought to him from Africa or South America is to be found here in abundance. They are so numerous that only a few well-known plants, entering into almost every medicinal preparation of the present day, can be named. Such are the aloe, castor-bean, valerian, rosemary, absinthe, senna, ipecacuanha, sassafras, camomile, cloves,

nutmegs, vanilla-bean, tamarinds, cubebs, and the camphor tree. This list could be extended indefinitely. In the floral line one can find in profusion, the several varieties of roses, frangipanni, jasmines, vervains, the passion-flower, and many other varieties whose fragrance perfumes the air the year around.

The mineral field of Haiti is as rich as its floral field. I quote from a report of Prof. Gabb, a geologist, sent by the government to report upon the mineral wealth of Santo Domingo, in 1870, at the time of the proposed annexation of that republic to the United States; his statement may be considered authentic, and will fully prove the extent and value of these mineral deposits. "No formation older than the secondary era," states Prof. Gabb, "has been found on the island; the oldest group being the great mass of slates, conglomerates and limestone which form its core. These are uplifted and broken by numerous intrusive masses of crystalline rocks, which may be, for convenience, grouped under the generic term of syenite, since they almost consist invariably of three necessary minerals, quartz, feldspar, and hornblende. Wherever the slates occur in the eruptive rocks, there gold occurs, in most, if not all, of the included quartz veins, and the streams are always more or less auriferous." It is also stated by another writer, that, at the time the mines were worked by the Spaniards, nuggets of gold were found containing 14 lbs. of pure gold. Hazard, another writer, states that some of the mines when first worked yielded so much silver that a mint was established, where money was struck off the same as in Spain. In the northern section of the republic is to be found, gold quartz, antimony, silver, jasper, talc, jet and agate. Copper is found in various sections yielding from 60 to 65 per cent. of pure copper; magnetic iron ore occurs, containing 67 to 68 per cent. of metallic iron. In the southern section of the island a mountain of magnetic iron is said to exist, as well as gold in paying quantities. Beds of the finest marble are found in the northern section, and also kaolin of fine quality. Coal fields of considerable extent have recently been discovered. A mountain of rock salt as clear as crystal lies in the southwestern part of the republic; and mineral springs, noted for their healing properties, are found in the northwest.

In a late work by W. S. Courtney, entitled, "The Gold Fields of Santo Domingo," he states, "The soil of the island is constituted

of the debris of the mountains and hills, and the decayed vegetation of past ages. In one place we find a rich vegetable mold; in another, a mixture of this mold with pebbles and sand; in another, a light, loose, spongy loam; in another, a loose marl; in another, a clayey marl; in another, a soil formed of dissolved or pulverized coral shells; and in another, of pure clay or sand. It differs, also, in color and depth as much as it differs in constitution and quality. Sometimes it is yellow, tho still retaining its productive qualities; sometimes it is red, sometimes of a bluish cast, sometimes of a dark, muddy or lava color; but most generally it is black, and its depth varies from six inches to ten feet. In the valleys and slopes, in and on the mountains and on the savannahs and plains, it is generally a rich, black loam, varying in depth from three to ten feet. The deepest and richest soil is found in the valleys, at and near the mouths of the principal rivers, and is made up of the alluvial deposits brought down by the streams. In regard to the productiveness of the soil, suffice it to say that notwithstanding its diversity and variety, it is prolific beyond anything found in the Antilles, and not excelled by that of the Italian peninsula or Sicily to which it bears a strong resemblance. Such a thing as a fertilizer, an article of such extended traffic and so necessary to the agriculturist, is not known or thought of here, nor will it, I apprehend, ever be required. The fertility and strength of the soil containing all the elementary constituents required to produce and mature the various vegetable growths, could not be exhausted even without any return to it for generations. Its fecundity is a marvel to the husbandmen of these latitudes." As a proof of this statement,—everything that can be produced in the temperate and tropical zones will yield abundantly here. All the garden vegetables can be found in as great abundance, and as fine in quality as in the states. Corn is simply planted by making a hole in the ground, placing therein the seed, and leaving the rest to nature. Sugar-cane needs to be planted but once in ten years; cotton, once in twenty years. Here the cotton shrub attains the proportion of a tree; this cotton consists of three varieties, one white, with a long silky fibre, similar to the Sea Island cotton, another yellow in texture, and lastly, one in which the fibre is pink. Rice is produced on the uplands. Coffee is planted once in ten years. This staple constitutes the principal revenue of the country; there was exported of this product this year 61,622,484 pounds, of cocoa 6,237,-

423 pounds, and of logwood 111,651,765 pounds. These constitute the principal exports.

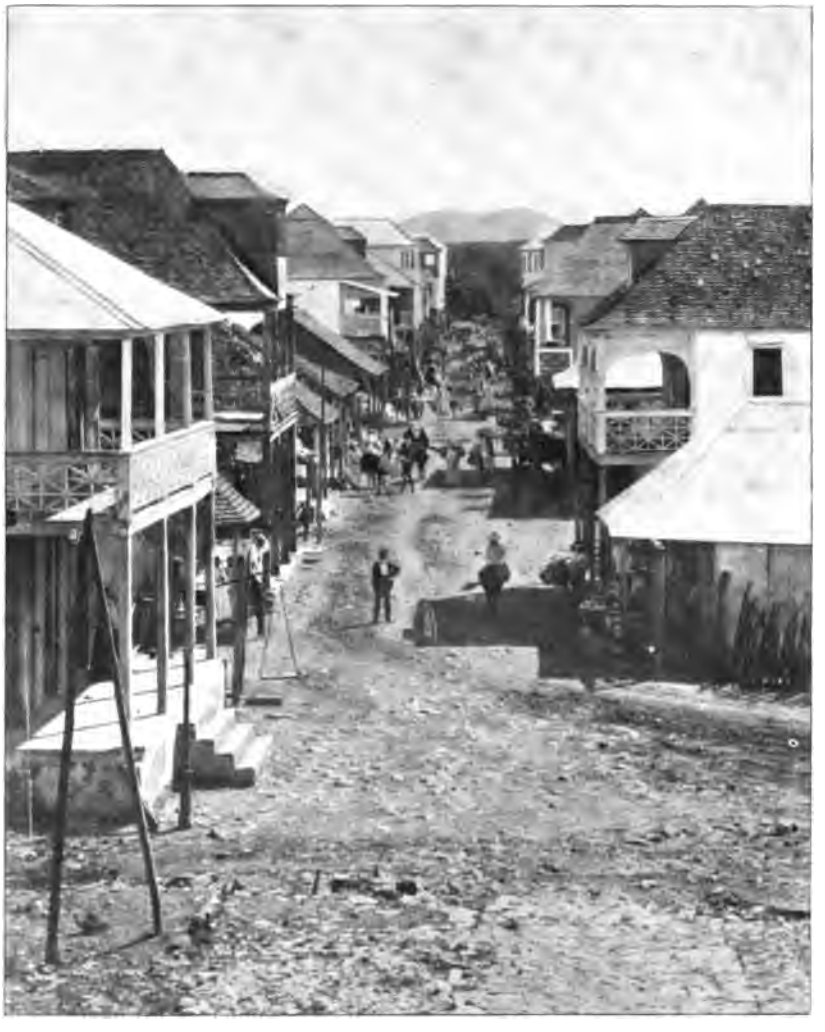
The climate of Haiti varies according to the section of the country. In no two sections have they the same climate. We would think the atmospheric range of one of the Antilles, would be that of all, but such is not the case. Her peculiar situation has given to Haiti greater and a more pleasing diversity of climate than her sister isles in the same group. In the hottest days, the temperature is never more than 92° or 93° F. The nights are always cool enough to make one's sleep refreshing; and one is always sure in this section (Port-au-Prince) to be greeted each morning with sunshine. In fact the sun shines 365 days in the year. Even in what is known as the rainy season, the mornings are always bright and clear. It seldom rains before four or five p. m., and these rains, tho heavy, do not last more than an hour; if it does not rain at the time named, rain occurs about eight or nine p. m. A peculiar feature is that this rainy season does not visit all sections of the island at the same period. In the north, the rainy season is from December to April, in the west, from March to June, in the south, from May to July. Another peculiar feature in regard to this rainy season particularly around and about Port-au-Prince—this city is in the Western Department or District, and is surrounded on three sides by mountains from 3000 to 4000 feet—is that it will rain in one part of the city while there is bright sunshine in the other, or the center may be visited by a heavy shower while the northern and southern sections are enjoying the rays of the sun. It may be well to add that this section of the island is never visited by those tropical storms or cyclones similar to the one Porto Rico suffered from last year. Tho the lightning is vivid, the electric current is never destructive, nor is the heat so severe as to cause sunstroke. Natives can be seen at times lying at midday in the rays of the sun without being affected by them.

The original inhabitants at the time of the discovery, were known as the "Caribs". They were an inoffensive and hospitable people, and gladly welcomed the Spaniards to the island, looking upon them as people come from some other planet to visit them. In a few years, they learned a different lesson. As the mineral riches of the island became known, the cupidity of the Spaniards was aroused to secure this wealth without labor on their part;

they, therefore, made these people slaves, compelling them to work in the mines. Their cruelty was such that the once populous island was laid waste and the greater part of the original inhabitants became extinct. In fact, in twenty-two years they were reduced in number from 2,500,000 to less than 10,000. This caused serious concern; to remedy it, Charles V. in 1510 gave a patent to one of his nobleman to transport 4000 negroes from Africa to the colony. The patent was afterwards sold to some Genoese merchant; this began the traffic known as "The African Slave Trade." These people being of a more hardy character were able to withstand the cruel treatment, and multiply. It is estimated, during the time the Spaniards held control, and afterwards the French, that about 400,000 of this class were brought from Africa. The descendents of this people are the present inhabitants of Haiti.

Before proceeding upon the next feature of this narrative, it is well to compare the condition of the island under the conquerors, the Spaniards and French, as history speaks of them as such and applies the term jointly. The Spaniards during a period of 200 years, when they were superseded by the French, made little or no improvement. Their primary object was to secure wealth in the quickest way, and with the least labor on their part. They did not seek to improve the country; they built no cities, constructed no roads, founded no institutions of any kind; their main object as has been stated was simply to acquire wealth. The French on their part sought by all means in their power, to improve the section of the island which came into their possession in 1789. From this period to the Independence (1804) is called by many "the golden epoch." In many ways the impression made by them was lasting. During this time they laid the foundation of many of the principal cities of which the best known is Cape Haitien. On account of the way in which it was laid out, its houses, plazas, etc., it was known as the "Paris of America." Good roads were constructed to all sections of the island, and kept in repair; agriculture received attention; they multiplied their plantations, increasing their area, and building fine mansions; they surrounded themselves with a large retinue of servants or slaves, and gave the names they now bear to many of the cities; finally, they changed the language of the people from the Spanish to the French. So rapidly did the wealth of the colonist increase, that Major Stewart

said in his reports, "It became a common proverb in Paris, to say, 'such a one is as rich as a Creole.' " All this was done within



STREET SCENE IN MIRAGOANE, HAITI.

a period of 110 years. It can thus be seen that greater improvements had been made by the French in that period than by the Spaniards in two hundred years.

The island of Tortuga, a small island north of Haiti, and a part of the republic, bears such an important part in this period of Haitian history, that we cannot pass it unnoticed. This was originally the home of the so-called Filibusters, known in history as the Buccaneers. These people made the island a rendezvous as well as an asylum; it was strongly fortified. From here they would sally forth to prey upon and capture the Spanish galleon, laden with the rich spoils from Mexico and the adjacent lands. They would kill or capture all on board, either scuttle the ship, or else bring it with its rich spoils to this island, where they concealed their treasure. If pursued, they would seek this island as a place of refuge, where they would be safe from all pursuit, no armed force feeling itself strong enough to attack them. As the Buccaneers became stronger, they gradually removed to the main land, or rather the larger island, Haiti. In 1652 they were recognized by Louis XIV. as a French Colony, and a French governor was sent to govern them. This was the beginning of the first French settlement in Haiti, and here subsequently took place some of the chief exploits of Sir Francis Drake, of the noted Capt. Kidd, and later of Lord Nelson, the great English admiral.

This brings us down to that period known as the period of Independence, in which the Blacks drove the French, and afterwards the English from the island, and asserted their independence, which they have ever since maintained, for a period of ninety-six years. The incidents of this period sound more like romance, than historic truth, and while well known here, are but little known to the people of the states. At the time the states were seeking their independence (1775-1783), France was in the zenith of her glory, having large and flourishing colonies in the north, west, and south of this island. When France decided to aid the states in their struggle for a distinct government, one if not two regiments were sent from the island, participating in those battles in which the French took part, and culminating in that final act, the surrender of Cornwallis, at Yorktown. These men on their return became imbued with a desire for greater freedom of action, more liberty than had been granted to them by the French government. Events were at this time shaping themselves in France that were to strengthen them in their view. They demanded from the home government the same privileges and rights exercised by the late American Colonies. The French government, then in

the hands of the Revolutionists, refused. The Haitians then resorted to force, but being defeated, called to their aid the colored class, that is the mulattoes, and all of a lighter hue; the French government finding it could not sustain itself against this combined force, called upon the blacks or the slaves to rise against their masters and the mulattoes. Up to this time the slaves had taken no part in the contest; with their aid the government was successful, and the colonists or planters defeated. It is at this period, that Toussaint appears upon the pages of Haitian history. A slave himself, he was a man of magnificent physique, and had already become a leader with his class; it is said he was fairly well educated, and could read French and Latin. His first effort was to prevent the slaves from taking any part in this matter. His efforts being unsuccessful, he turned his attention to preserving the lives of his master's family, and sent them to the Cape (Cape Haitien). He then joined the slaves and by his personal magnetism caused the mulattoes to withdraw their aid from the whites, and make cause with him against the common enemy. Chosen the leader of this combined force, tho having no military knowledge, he soon developed into one of the military heroes of the age. In a short time he converted his demoralized force into a strong and well disciplined army, subdued the planters and drove their forces from city to city, and finally compelled them to recognize and acknowledge the sovereignty of France. His whole course was marked by humanity toward the vanquished. During the war he prevented his followers from slaying the prisoners that came into their hands, and at all times protected the women, and caused them to be treated kindly. Thruout this war he appears as the friend of the whites, and the active ally of the French government, ever ready to recognize its authority. Shortly after this, the English made a landing, seizing a portion of the island; Toussaint again took the field, finally defeated them, and compelled them to leave. Napoleon fearing this man's influence, had him decoyed on board a French frigate and conveyed to France; upon reaching there, he was confined in one of the fortresses near the French Alps, where in a short time he died. The perfidy on the part of the French and the subsequent death of Toussaint, aroused the most intense hatred toward them, as Toussaint was almost an idol with the people. Their hatred was still further inflamed as it was said, it was the intention of France to enslave them again. A spark

was only needed to carry their plans into execution, and this was soon given. The years of 1802 and 1803 are ever memorable in Haitian history, in the visitation of the terrible yellow Jack that decimated most of the Haitian cities, and the massacre of the whites by the blacks led by Dessalines, Petion, and Rigaud. The blacks, conscious of their strength, spared none; men, women and children fell beneath their ruthless aim. In fact, every white person that could not escape, fell before the pitiless knife; even many of the mulattoes were numbered among the victims, as they had sided with their oppressors in the former struggle. After the French had been driven out, a constitution was framed, in which they declared themselves free and independent. Haitian independence dates not to Toussaint, but to those men whose names appear above, and several years after he had been conveyed to France.

The Government of Haiti is liberal, patented more from the French than that of the States. It consists of three departments: Executive, Legislative, and Judicial. The Legislative consists of the Senate and Chamber of Deputies, the latter only representing the popular will, the members being elected by the people for a term of five years, and the Senate being chosen by the Chamber of Deputies for a term of six years. The President is elected by the National Assembly, (Senate and Chamber of Deputies), in joint session, for a term of seven years. The Judges are appointed by the President.

In the large cities, there is to be found a well equipped system of schools. At the capital they have a seminary for the boys, and another for girls, also a law and medical school, all receiving state support. The wealthier class send their children either to France or Germany to complete their education. In the country there are but few schools, on account of the thinly settled communities.

Religion is free to all; tho the Roman Catholic is in the ascendency, there are many Methodist, Episcopal, and Baptist churches, all having large congregations. Many articles have appeared in papers and magazines, speaking of the cannibalistic character of the people—that they were given during the time of certain religious festivals to eating human flesh, and drinking human blood. One of the foreign consuls, in an official report to his government, stated that human flesh was sold at so much a pound in the market place at the capital. On account of his official character, this report received a wide circulation. There was no truth in it. Some

of his friends had told him the story, at a time he was in a *mellow* state, more to play upon his fancy; he accepted it as true, and embodied it in an official report. There is no truth in any of these statements, and the many stories I have heard, have always proved to be false. Much has also been said of the practice of voodooism, by all classes; this is to a certain extent true. Voodooism prevails to a limited extent in the interior, no doubt, but it is under the bans of the government, and, if practiced at all, is practiced secretly.

The natives are very hospitable. Whenever you travel, if night overtakes you before you reach your destination, the first house you may come to will offer you shelter for yourself and horse; supper and bed will be provided, and, in the morning, at the hour you arise, breakfast will be ready. If you desire to pay them for what you have received, they consider it an insult; they feel it is a right and privilege given to them to entertain you.

MODELING MT. SHASTA

BY R. S. HOLWAY, STATE NORMAL SCHOOL, SAN JOSE, CAL.

During the past semester, my students in the physical geography classes have made a model of Mt. Shasta. They have so thoroly enjoyed the work, and the building up of the mountain has so interested visiting teachers that I send the Bulletin this brief account of our experience. Such modeling is, of course, done more scientifically and skillfully by the advanced students at the universities. This article is written for the common schools, where, as with us, teachers and pupils have had no special instruction in geographical laboratories.

There were two distinctly impelling causes of our taking up the work. One was the fact that we had been using the topographical maps of the Geological Survey, without the full interest and profit, which it seemed to me they deserved. The other was the fact that I had been observing the sand modeling of the classes in geography methods and criticizing the very great exaggeration in vertical heights. These had (very rightly, I presume) been defended in such kind of work, on the ground that exaggeration was necessary with children, in order that they might be given a right idea of the ruggedness of a mountainous country. While this may

be true, a great deal of work had to be done in the advanced classes, to correct the false ideas of relief held by our senior students. I finally suggested that we could give correct ideas of mountains by modeling smaller sections and using the same scale vertically and horizontally. Mt Shasta was chosen for two reasons: it is in our own state and stands almost alone, making an easy subject for a first attempt. Furthermore, it is of general interest to all students of physical geography, because it is a typical young volcanic mountain.

The project was proposed to my classes and very readily undertaken by them. Contour maps had already been used somewhat by the students. We carefully studied the "Shasta Special" topographic map and decided to cut a map on each contour interval

FIG. I.

shown by the dark brown lines,—that is, for every five hundred feet. Then each section was plainly marked, for example, "5,500 foot level," and pasted on cardboard. Then with sharp knives, the cardboard was trimmed to the contour interval. On the scale of the map, 1 in. 1 mi., it would, of course, take cardboard nearly one-tenth of an inch in thickness to represent sections of the mountain five hundred feet in thickness. We were unable to find material of exactly that description and were obliged to use two thicknesses for each layer. Even then, on finally putting our lay-

ers together to build up the mountain, we had to insert sheets of thin paper to bring our vertical relief to exactly the same scale as the horizontal. It will be noticed that one of the regular maps can easily be used for several sections by using the center for sections near the top, and the outside for a section near the base. The work was divided among as many students as could obtain material; and when the sections were all ready, we began building the mountain.

FIG. II.

A sheet of cardboard was fastened to a board and marked "3,000 foot level," the lowest ground on the map and showing only the valley of the Sacramento. Then the 3,500 foot sections were put in place, one on each side of the river, and the mountain built upward in that manner.

Fig. I is from a photograph showing the lower sections in place, the middle sections scattered about, and the upper sections forming the peak put together at one side. As the mountain was built up, the different pieces were pasted and put under pressure; and from time to time, slender wire nails were put thru, to make everything firm.

Fig. II gives a side view of the model after all the sections were in place. The whole model was next given a coat of paint, and then the steps or terraces filled in with putty. While doing

this, the map was consulted constantly for suggestions as to slope. Especial care was given to the water-courses and to the small cinder-cones scattered about. Then another coat of paint was given over the putty. When that was dry, the glaciers were shown in white paint, and the cliffs between built up with putty and paint. The streams in the different cañons were traced with the conventional blue line, and the course of the railroad, in black.

Fig. III is a view of the completed model, showing the mountain as seen from the town of Sisson, but of course without the mantle of forest and snow. It was very interesting to note the effect of the completed model on the minds of different students. Some were surprised at the flatness of the mountain, and some

FIG. III.

were surprised to find it so high. Two or three of the students had lived within sight of the mountain, but none had made its ascent. They all testified to the naturalness of the model, provided of course, that it was viewed with the eye on the same level as the country around Mt. Shasta. To give them a standard of comparison, a piece of paper was cut to show our Normal grounds of nearly thirty acres, on the same scale as the model. The paper was placed on the site of the town of Sisson, and its smallness made one realize better than in any other way the size and grandeur of the mountain. A very common remark which I over-

heard during the progress of the work was, " Well now I understand those contour interval maps."

On the whole, I think that the majority of the class were disappointed that the model was not higher, but they are all better satisfied with their ideas of mountains, and they begin to have a better conception of the height of mountains compared to the size of the earth. They are also able to see that the making of a great mountain range is making a comparatively small wrinkle on the surface of the globe. As the model is made from the correct maps of the geological survey, it must be very nearly true, and we have been asked to have it copied in plaster. We can have this done for the use of schools whose students must be denied the pleasure of making one for themselves.

But there is really no great difficulty in this work. It can be carried thru in the upper grammar grades by any teacher who is interested in the work, and who is not afraid of a little apparent confusion at the time of cutting the sections. If thicker layers are used, every section might represent one thousand feet, and only half the number of layers be used. Then, however, the labor of correctly filling in with putty would be increased. Possibly it should be stated here that putty was chosen instead of papier-mâché, or wax, because it is a principle in our Normal to use, when possible, such material as is easily obtainable in a country school. Our experience has been so satisfactory that this semester I shall propose to my classes to undertake the more difficult task of modeling a section of our own valley, from Lick Observatory on the east to the mountains beyond Stanford on the west.

A SCHOOL ORRERY

BY G. P. RECLUS-GUYOU, EDINBURGH, SCOTLAND

We generally teach in schools that the orbit of the earth round the sun is an ellipse, one focus of which is the centre of the sun. But there is a difficulty; at the age when it is useful to teach children the general movement of the earth and its effect upon the life on our planet, they are hardly ready to study the geometrical properties of the ellipse. And, on the other hand, the above definition of the orbit of the earth is only a first approximation; we have afterwards to show how the moon and other bodies make the earth deflect from its elliptical path.

Now for all practical purposes the eccentricity of the theoretical ellipse is so small that it can be replaced by a *mean circle* with an error hardly greater than the perturbation caused by the moon. In other words, the path of the earth is really a complicated and ever-changing curve, but we can study it easily in all its details, by considering it first as a circle eccentric to the sun.

It is then a very simple matter to have an orrery constructed and kept going by very young children. Considering it essential that the size of the earth should be in scale with the solar distance, the orrery is best constructed in the open, on a flat piece of lawn which it does not damage.

To give an instance: Let us draw a circle of forty feet radius as a mean path of the earth, the diameter of the latter will be in proportion about one twenty-fourth of an inch, and other dimensions as follows:

Diameter of orrery.....Inches,	960.000
Solar distance.....	480.000
Diameter of sun.....	4.444
Eccentricity of sun.....	8.040
Diameter of earth.....	0.041

Two diameters, $A\ O\ A'$ and $C\ O\ C'$, perpendicular to one another are drawn, and on one of these (on $O\ A$) the position S of the sun is marked.

If the mean circle is admitted to be as much outside the theoretical ellipse in C as inside in A, it is easily calculated that the error (greatest in A and C) amounts only to 0.034 inch.

A is the point of the orbit nearest to the sun, the perihelion whose date is found in the almanac. Now we must find the position of the earth on its path at other dates. Starting from A, we divide the circle into 52 equal parts. The side of the regular polygon is 57.963 inches.

Let m be one of the points of division. Obviously a point M must be found such that area ASM equal area AOm. Let us draw Sm, and Op perpendicular to Sm. Then $mM=Op$, giving at once the point M. Especially simple is the correction of the thirteenth division point $CB=OS$.

We thus have 52 division points which are symmetrical on either side of AA'. The arcs meeting in the perihelion A are longest (inches 58.950); those meeting in the Aphelion A' are shortest (inches 56.992). But tho of unequal lengths, each one is covered by the earth in the same time; 1-52 of a year, or 7 days, 34 minutes, 47 seconds.

It happens that for the year 1900 and for years to come, the earth is nearest to the sun on the first of January. Then if A is noon of Monday, January 1st, 1900, turning round counter-clockwise, we can inscribe a date and hour to every one of the 52 division points.

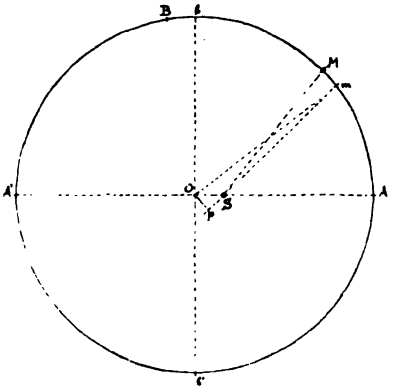
We may practically admit the motion of the earth to be regular within a week, and without constructing more points, simply dividing the arcs proportionally to time, we can find the position of the earth at any moment; 1-7 of every one of the 52 arcs is covered in 24 hours, 4 minutes, and 58 seconds; 1-24 of each of these in 1 hour and $12\frac{1}{2}$ seconds.

Special points to be marked are those of the four seasons, whose date and time are given in every almanac, and whose positions are easily verified in joining the two equinoctial points and the two solsticial points; the lines thus formed must cross in S and be normal to one another.

Having the line of solstices, we can give the direction of the earth's axis, north pole upward, inclined by 23° 27′ on the vertical.

Elementary notions of geometry and the explanation of the law of equal areas will be sufficient to make the construction of such an orrery clear to every child.

As permanent traces of it on the lawn, there ought only to be the main points, *O*, *S*, the four Seasons' points, and the 52 division points, each marked by a short tube (of copper, for instance) driven into the ground. The orrery is made most simply by inclining these tubes at the angle which the earth's axis forms



with the solar plane. The globes, sun and earth, are then only to be mounted on their axes with a straight prolongation fitting into the tube and of such length as to keep the centers of the globes in the same plane.

There ought to be at least two terrestrial globes, one at a scale (0.041) for the study of the movements of the earth, and another one of usual size, free to move round its axis, to illustrate the consequences of the earth's movements in the alternation of day and night, of winter and summer. Another necessary implement is a lunar distance to scale, the moon itself being not much larger than a mere point.

Any number of developments and improvements upon such an orrery may be readily imagined, but in its simplest form it is quite sufficient to study the minutest details of the internal solar system.

It will serve for the comprehension of what everyone will admit to be part of the very foundation of geography. It will dispel wrong impressions which children get from books where no figure can be drawn to scale or in accurate form. It will visualize abstract astronomy.

Here are some dimensions which may be found useful:

With a solar distance of	Inches, 480.000
we have Lunar distance	1.243
Diameter of Moon	0.011
Earthly Deflection caused by the Moon	0.016
Yearly value of Precession of Equinoxes, retrograde	0.117
Yearly value of Movement of Perihelion, direct	0.027
Yearly variation of Solar distance, (Aphelion less Perihelion)=13 Lunar distances	8.080

GEOGRAPHY AS SEEN BY THE CHILD

BY RALPH P. IRELAND, PRINCIPAL OF SCHOOLS, GLOUCESTER, MASS.

The child who is studying geography in a progressive school today is fortunate in many ways. New friends are coming to him: helping hands are stretched out to him from the colleges and normal schools. In place of his worry and perplexity over his task has come the anxious thought of the author and others to provide lessons which should be so related to his own experiences as to make the study of geography a delight. Encouraged by this assurance of increasing interest in the child's welfare, I hope a few notes concerning his actual attainments may not prove to be without interest or value.

The greatest difficulty confronting the child generally is his very limited stock of experiences. Probably in no study is he so hampered by this as in geography. Lack of experiences must result in a correspondingly limited variety of ideas and meager vocabulary so far as this study is concerned. Moreover it renders what passes for ordinary language frequently without meaning.

Suppose he finds in his geography or elsewhere a sentence something like this—"The Merrimac river furnishes abundant water power to many factories." At first sight it would seem that a simpler sentence could hardly be found. The child may not find it so. Many places have no factories operated by water power. Very many children have never seen a factory of any sort. Most of the children with whom I work have never seen a river. Take another sentence almost as simple. "The rainfall of this region

is so scanty that irrigation is necessary." The meaning of the word *irrigation* must of course be found and there the learner frequently stops. The magnitude of the irrigation works, how it happens that there is water which may be stored, how it is applied to the crop, and other like matters necessary to the understanding of what is implied by the word irrigation, are so utterly unknown as to excite no curiosity.

It will doubtless be said that there is no time to enter into the details of any subject. True, but why trouble the child with anything of the sort, unless it can be made real to him? When the simplest geographical statements are so likely to prove thus difficult, it may easily be inferred how meaningless the more complex ones may be.

While some subjects fail thus of being understood at all, others are imperfectly comprehended, and erroneous ideas are planted in the child's mind. In the case of that sort which is related below, it should be remembered that the children concerned lived at the seashore, on the slopes of rather steep, rocky hills. None of these hills were more than two hundred feet high, and most were less than one hundred feet high. One day I found a class of pupils who firmly believed the prairies in all cases to be lower than their own homes. Investigating the matter, it was found that this belief was general. That the prairies possessed an elevation exceeding in many places one thousand feet, was to them incredible. All the plains they had ever seen were at the bases of hills. To think of plains as higher than the hills they knew, was to turn things topsy turvy. It would certainly be interesting to discover how accurate an idea of the elevation of the New England hill country is generally held by the children who live on the prairies. In the same class with the error recounted above are such as these: that mountains arise from plains; that valleys are necessarily low; that a river waters a region by merely flowing thru it.

Still another group of incorrect ideas quite generally held by children in the lower grades, is of some interest here as indicating their inability to obtain any serviceable idea of the earth as a whole. Thus if a question like this is asked, "Can the people in Argentine see the North Star?" while a negative answer will generally be given, the invisibility will as generally be attributed to distance and not to curvature of the earth. In common with many older people, while giving intellectual assent to the contrary, the children

are perfectly satisfied with a flat earth. Similarly, foreign places are thought of as merely remote, never beneath, no idea of an intervening curvature of the earth's surface being present. Whether a more general use of globes and other illustrative apparatus, rather than maps, would greatly mend this, is an open question.

The last point to be considered here is directly in line with the above question; viz., the amount of good derived by small children from seeing experiments performed, or from the use of illustrative apparatus. It is doubtless great, but still may be rather less than has been supposed. It is probably greatest when the materials used are of the simplest and most familiar character. I have known so simple an experiment as the evaporation of water in the sunlight to be profitless, because an oddly decorated tumbler was used.

It is beyond the power of anyone to foresee upon what detail of an experiment a child's mind may fix, to the practical exclusion of the rest, or whether indeed it will fix upon something unrelated to the experiment. It is usually assumed that a child will desire to know the meaning of what he sees, and so be stimulated to active thought. Yet evidence is not wanting to show that many children are so pleased with anything novel or mysterious, as to have a positive disrelish for any explanation. A boy will break open but few of his firecrackers to learn how the noise is made. It may be stated as usually true that it is the experiment itself or the operation of the apparatus which is interesting, rather than the meaning of it. No truer rule for teaching exists than to adapt the teaching to the child. To do this we must see things as they appear to him. The incidents noted in this article may serve perhaps as a very short step in that direction.

GEOGRAPHY WORK FOR PRIMARY CHILDREN IN CITY SCHOOLS

BY EDGAR R. BROWN, PRINCIPAL, CAMDEN ST. SCHOOL, NEWARK, N. J.

No study brings us into closer relationship with nature and the facts of social life than geography; it is really the study of the earth as the home of man. To give children knowledge of their environment, and to bring them into harmony with it, are important aims in education. In consideration of these facts, the value and importance of geography as a study is evident; it is also one of deepest interest when properly taught.

Unfortunately, the idea of geography teaching commonly in vogue twenty-five years ago is not entirely passed away; it was not then often made an interesting study. The first lesson was to learn a page of definitions, the last of which was an unfathomable combination of words in answer to the question, "What is a sound?" The work was dry business, and too often the pupil came to believe with his teacher that he was hopelessly slow and stupid. Sometimes, fortified in spirit by the good maxim "knowledge is power," page after page of meaningless definitions were memorized, and the names of countless capes, rivers, bays, and towns learned, together with the area of the various states and territories and their population by the last census.

The study of geography should begin with observation of various phases of nature as manifested in our every day life, supplemented by oral instruction and explanation on the part of the teacher; she will lead her pupils to realize that geography has to do with real things, knowledge of which they may gain thru their senses. The first teachings of this subject must be vivid and real. Clear, accurate mental pictures are the foundation for all further acquisition of knowledge. When facts have been associated with forms in certain definite types, constructive imagination can do its work. But imagination cannot construct pictures

out of nothing; it works from the materials of experience. When children come to study the climate, surface, products, industries, and commerce of other communities or distant lands, the ability to form correct mental pictures must depend upon correct conceptions of things already seen. Primary geography, if successfully taught, will give the child the material from which the mental pictures of distant objects and places will be formed; he is here to gain the experience in the light of which in his further study he shall be able to interpret all maps and descriptions.

City schools are not favored with opportunities for the study of local geography equal to those in smaller places. But, remembering that the human element is to be made the most prominent in all teaching of geography, a course of much interest and value may be laid down and followed. Newark, N. J., is a manufacturing city with a population of 270,000. Its course of study, as planned by Charles B. Gilbert, superintendent of schools, has for the first year work the study of plants and animals and natural phenomena, as forms of water and other features suggested by outlines of nature study; observing weather; making calendars; directions of winds; and the points of the compass. The child is making the acquaintance of the world.

In the second year there is a continuation of the study of plants and animals and natural phenomena; calendar work; currents of air; winds and relation of wind and weather; drawing to scale; observations made from schoolroom windows and out-of-doors; school yard and field excursions, with sand maps of local features; also stories of children of various lands.

In the third grade there is a review of the work of the preceding grades; calendar work; forms of land and water from local observation; drawing to scale, and study of relief maps; local geography and history; physical features of Newark and vicinity; river and mountain, how formed, and uses; how and why people travel; also stories of the early settlements in New Jersey and New York with geographical reasons.

In the fourth year the use of the text-book is begun. There is some study of the world as a whole suggested by imaginary journeys around the world in different directions; continents and oceans; our relations to different continents—historical and commercial; a little about the people who have lived upon them; zones of heat and cold; local observations and field lessons with drawing

to scale of such familiar places as the school yard, acquainting the child with the use of the map; the study of North America in its main features, as to great mountain ranges and river systems, acquainting the child with geographical terms thru local instances; many field lessons for the sake of acquainting the child with geographical nomenclature and ideas; also, study of South America and of Europe as to main physical features, and their relations, commercial and otherwise, to us.

This course is given as an interesting example of one that I believe is excellent pedagogically, and know to be practical in its work for the education of the child. The first three years refer almost entirely to local geography, and the work is carried on in close connection with nature study and language. In accordance with a special outline, the city itself is studied as to its history, its location, and its physical features; its productive occupations, commercial facilities, and educational and social advantages, are systematically considered; and finally, an idea of its government is given, and the map idea implanted by drawing to scale. By personal inspection and experience, children become acquainted with the manufacture of common staple necessities; the idea of commerce and trade centers becomes clearer; notions of city government are formed; ideas as to a river, hill, field, valley, slope, island, etc., are now well in mind, while climate, the seasons, and the phenomena of the weather, have been not only seen but closely observed. The educational principle, "from the known to the unknown," is now in process of practical application. By this preliminary work a sure, concrete footing is made for all successive steps in geography study. There is also a very practical side to this method of studying one's surroundings as type forms; the knowledge value is great, considering the common ignorance of many intelligent people concerning important things about home. It is a faulty educational system that allows any child to leave school ignorant of affairs of interest and importance that lie within his reach.

Excursions are necessary for the successful execution of such work as spoken of above. Excursions are not popular with teachers, tho usually so with children. But attempts to discuss topics, without observation, such as a trip from the schoolroom direct into this great world of realities gives, are likely to grow formal and of doubtful value. Occasional excursions are not only

desirable, but necessary, tho it is often a real burden to go with a large class of children. The teacher needs to plan the trip as definitely as possible beforehand; after returning to school, the observations gathered should be talked about in class, explanations made, wrong ideas corrected, and important points emphasized. The objects, machines, or processes seen, and new ideas gained, should be represented by drawing, cutting, modeling, or by other means of free expression. The interest shown, and the renewed enthusiasm for school will amply repay all extra trouble. To successfully carry out excursions in connection with schoolroom work is well worth the ambition of all progressive teachers. A well conducted excursion is proof of good discipline and insight into the art of teaching. The teacher here shows special understanding of individual children, and her power to lead children to self-activity and original thought; she will meet with repeated situations that call for a variety of skill and device. An occasional excursion is better for the teacher herself than continuous schoolroom routine. Those who have not tried such a trip should do so. All practical difficulties can be met by that teacher who has the will to know and to do the best thing for the child, and who has the spirit of right pedagogical methods.

ON THE PHYSICAL GEOGRAPHY OF A NORTHERN SECTION OF THE APPALACHIAN MOUNTAIN SYSTEM

BY JOHN A. DRESSER, RICHMOND, PROVINCE OF QUEBEC

That part of the Appalachian mountain system, which lies within the province of Quebec from the Vermont boundary line to the St. Lawrence river in the vicinity of the city of Quebec, is generally known as the Notre Dame mountains, and the greater part of the district which they occupy, as the "Eastern Townships." These mountains are the declining, tho unbroken, extension northward of the Green mountains of Vermont, and the White mountains of New Hampshire; and altho they do not rise to the majestic heights which characterize the many well-known peaks at the south, they yet give very distinctive features to the landscape of southeastern Quebec, and have very materially affected its development in the past, and must continue to do so with no less importance in the future. It is a region of great geological complexity, but the structural features which need to be considered for geographic purposes are of a more uniform character. Yielding to great lateral pressure thru long periods of ancient time, the strata of the region have been gathered into wave-like folds, which run in a general northeasterly direction, and vary in size from an amplitude of a few rods to anticlinal structures that form mountain ranges, which, despite an enormous erosion, are still upwards of two thousand feet in height. They decrease in elevation towards the northeast, and become inconspicuous at some distance below Quebec city. In the grander form in which they reappear in the Gaspé peninsula, they are known as the Shickshock mountains.

Altho the region of the Notre Dame mountains has been one of great erosion, as well as structural complexity, and consequently its true geologic features are often very difficult to discern, yet the dependence of important topographic forms upon them is very readily apparent. The trend of the long hills of harder or more

enduring strata is prevailingly parallel to the main axes of folding, and consequently the intervening valleys, whether caused by folding or erosion, have the same northeast and southwest direction. But these are only secondary valleys of drainage; for the principal rivers, such as the St. Francis and Chaudière, have their courses transverse to the mountain ranges, still in the main retaining their pre-Appalachian valleys, and run in a northwesterly direction to the St. Lawrence river of which they are themselves tributaries. These antecedent rivers have been strengthened by the inclosing of weaker ones, which, being unable to cross the barriers raised by the Appalachians, have turned their courses into the longitudinal valleys and so become their tributaries. Thus these river valleys which are again approaching the stage of maturity are often much older than the valleys of their tributaries. It accordingly happens that several of the tributaries still empty into the larger rivers with a considerable fall, thus giving rise to the best water power of the district. The city of Sherbrooke, an important manufacturing center, owes its existence, in a large measure at least, to the magnificent water power afforded by the Magog in its precipitous descent to join the St. Francis at that point. The Wattopekah is an eastern tributary of the St. Francis, which also joins it by a succession of small falls, large enough, however, to furnish excellent water power for the pulp and paper industries which give rise to the flourishing town of Windsor Mills. The numerous smaller mills thruout the country, which mark the earliest points of settlement, are most frequently situated on the east and west running streams.

The course of the chief glacial action in this region has also been generally transverse to the mountain ranges, and so has tended to produce, or aid in producing similar results; viz., to give the east and west running valleys the best water power for manufacturing, as well as the best soils for agricultural purposes. But if the valleys have contributed much to the modifications of settlement and development of the country, the hills have not done less. They have been the sites of the earliest clearances, except those made by the beaver, of the first artificial roads, the first tillage, and the greatest land waste, and now form the best pastures and consequently the basis of the important industry of dairying.

Under the French regime the settlements of southern Quebec were confined to the St. Lawrence valley, and the more easily navi-

gable parts of its tributaries, especially the Richelieu, so that it was not until the closing years of the eighteenth century that the "Eastern Townships" had other human occupants than the Indian or the venturesome hunter. Then the settlement was rapidly made by immigration from New England and from the British Isles. In either case long journeys had to be made to enter the new country, and the rivers formed the first and natural highways.

But the first artificial roads *leading away from the rivers* necessarily followed the hills, generally the ridges forming the divides between two tributaries, in order to avoid swamps, lakes, or other streams. A military road built about 1805 from the city of Quebec to Richmond on the St. Francis river, seems to have followed as far as possible the ridges along the northwestern border of the Appalachian folding, while the railway between the points, built half a century later, by a very slight detour avoided the hills almost entirely. Similar instances may be enumerated in almost any section of the country, where the ridges on which the mountain roads have been built have often received the well earned name of "hog's-backs." Besides the drier soil, the character of the timber was the chief reason for the hills being the first clearances. In general, hardwood trees (Angiosperms) grew upon the hills, soft wood (Gymnosperms) in the moister valleys. And as the first step for the settler was to clear the land, so the first return from his labor was the "pearl-ash," or potash, made from the ashes of hardwood trees. This was formerly the only known source of potassium carbonate, and hence found a sure market. It also derived additional importance from the fact that in the scarcity of money during the early settlement of the country it was commonly adopted as a basis of exchange, and became recognized as a legal tender for the payment of debt.

The use of hardwood for winter fuel was almost a necessity, and the sugar maple lent its peculiar value to the hardwood highlands, while the potash and other sources of fertility conveyed to the soil by their leaf mold, perhaps, gave them the greatest value of all.

The loss to the soil by the rapid erosion of the hills consequent on the beginning of cultivation must be considered in connection with another distinction of highland and lowland that is of primary importance to the agricultural life of the country. The whole region has been glaciated and the soils are in all cases

largely of transported material. In a period of post-glacial submergence, the till and strictly glacial deposits have been reassorted, or covered by clays and sands, up to an elevation of from five hundred to eight hundred feet above present sea-level, an altitude that embraces all the larger valleys and depressions of the area in question. Both the sands and clays in their lower levels contain organic remains of the usual Pleistocene types, and the clays at least are frequently stratified in a very distinct manner. They form a strong soil well adapted to grain raising, are often somewhat calcareous, and are frequently used for the manufacture of brick. Where a due admixture of sand occurs they pass into loams which are of exceeding fertility, being only equalled by the alluvial river flats. Like the sands they are free from stones, either boulders or blocks.

On the other hand the hills with their covering of glacial debris which have remained unsubmerged, have not been so favorably modified. In the first instance it is usually a shallow soil and must remain essentially a stony one Then, altho the atmospheric agencies, along with the abrasion of tillage, are breaking up the glacial gravels and boulders and the local rock waste, and are thus contributing to the value of a soil which otherwise possesses considerable fertility, yet the drainage from an average rainfall of forty inches a year involves a constant waste and one that increases rapidly as the land is cleared. Whether the land is wooded or cleared, the valleys are the natural recipients of the material washed down from the soil of the hills, but with the cultivation of the land, the removal by drainage is greatly accelerated. When the roots of trees, shrubs, or even grass, have been taken out of the soil or have disappeared from decay, the land loses much of its power to retain the rainfall; and as the soil is loosened in the processes of cultivation, it loses greatly in its power of resisting removal. The loss to the highlands is further increased by the fact that the portions of soil thus removed are those which are finest and consequently most valuable, while the stones are left and thus increase in proportion, if the amount of soil removed by drainage be greater than the waste received from rock decay.

Hence, when at the end of half or three-quarters of a century of settlement, the lowlands are brought under cultivation, they are found to be far more profitable farming lands after the first cost of artificial drainage has been met. The owner of the new lowland

farm gains steadily upon the occupant of the old homestead on the hills, altho the farm of the latter may have had the advantage (?) of a longer tillage.

When a once forested country has reached the stage of cultivation in which agricultural machinery can be employed, in sowing, tending, and harvesting the crops, and much of the hand labor is dispensed with, there is at once a decline in the rural population. The day laborer and the small farmer, who was also wont to serve as a "spare hand" upon the larger farms, eventually remove to the towns and centers of manufacturing, lumbering, or mining. The small farms are thus apt either to be acquired by the larger landholder, or, if they fall into poor condition thru defective methods of farming, they not infrequently become vacant and remain, perhaps, altogether unused for several years, especially during times of commercial depression. These deserted farms are, however, to be found upon the hills, rarely, if ever, in the valleys, and at the present time, owing to increased prosperity, perhaps connected with the rapid development of the dairying industry, much of such land is being reclaimed in the eastern townships.

The success of this industry as compared with other branches of agriculture is itself a result of geographical conditions. The well drained hills furnish excellent pasturage, while the numerous springs bursting forth from the too sharply folded rocks, or the faulted beds of clay, afford an abundant supply of the best water. While, on the other hand, altho the lowland fields and meadows yield more than enough for local consumption, they can never compete in the grain and cattle raising industries with the prairie lands of the great West.

Besides the development to the utmost of such resources as their water power and their mineral deposits, and the consequent manufactures, the chief economic questions arising out of the physiographic conditions which the inhabitants of the eastern townships have to face, in the near future, are the radical improvement of their roads, the concentration of the country schools, and the constant improvement of the methods of agriculture, with a view to their better adaptation to the changing stages of the country's growth.

LAKE McDONALD AND VICINITY

BY JOHN M. HOLZINGER, STATE NORMAL SCHOOL, WINONA, MINN.

In July, 1898, the writer, accompanied by Mr. James Blake, spent a part of his summer vacation in northwestern Montana, in the vicinity of Lake McDonald. Primarily on bryological pleasure bent, we also found so much that is of physiographic interest that I have ventured to offer the following reminiscences to the readers of the Bulletin.

LAKE McDONALD

The region visited is in the very "Heart of the Rockies," along the line of the Great Northern Railway. Indeed, until this railway pierced the backbone of our continent, not much over a decade ago, it was not possible, in a short vacation trip, to reach these isolated, rock-hemmed mountain basins. It is even now a task requiring physical endurance, and some courage, to follow the guide—in our case a hunter of the mountain goat, bear, and mountain lion—up and down the precipitous, untrodden mountain sides, over baby moraines, and even over the small glaciers, evidently remnants of once mighty ice streams. And the writer confesses that, but for the rich moss flora which presented itself everywhere along the route of our several excursions, naturally riveting the eye to the wall along which we would cautiously creep, and diverting the attention from the precipitous and occasionally almost abyssal declivities immediately beneath us, he would not care to again go over the ground.

The station at which we were advised to leave the railroad is Belton, some thirty miles east of Kalispell. This we found to consist of a number of cottages and a board building, which, for three months or so in the summer, during the tourist's season, serves as a depot, express and telegraph office. The distance to the foot of Lake McDonald is about three miles. This lake stretches some twenty miles northward, and has an average width of less than five miles. A small steamer, the F. I. Whitney, takes the tourist and his camp outfit to the north end, where is Hotel Glacier, and farther on the winter cabins of Comeau and of John Geduhn. Both these lone mountain dwellers, as well as Charles Howes, who with his wife spends his winters in his cabin at the south end of the lake, act as guides to the tourists in the summer season. We pitched our first camp within sight of Hotel Glacier. It proved to be our permanent camp, from which we made our several trips.

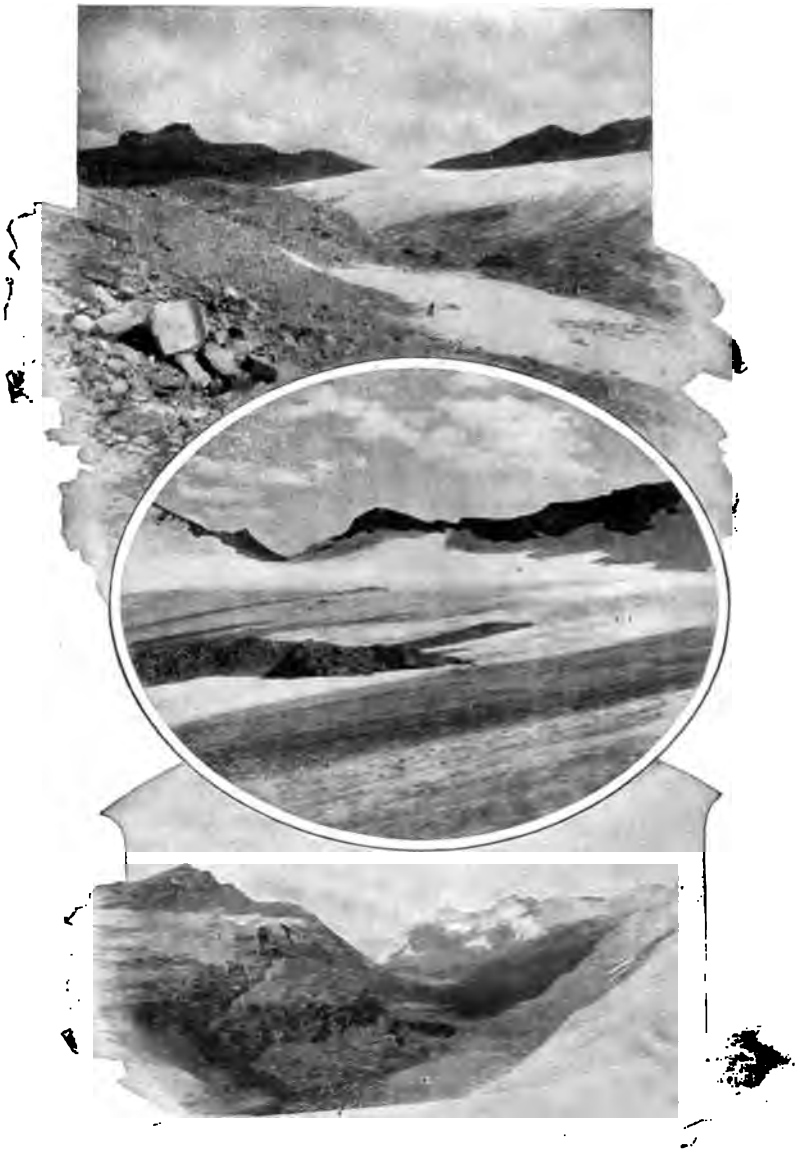
According to the railroad surveys, Lake McDonald is about 3,500 feet above sea level. Around its south end, and on both sides, it is bordered by low, gently sloping moraine hills which, some miles back, reach a height of 600–800 feet above the lake level. Around the north end stand a group of stately, partly isolated mountains which rise from 4,000 to 6,000 feet above their immediate surroundings. Charles Howes, whom we afterwards engaged as our guide, named them for us. In the order from left to right, facing north, they are: Mt. Lottie Stanton, almost hiding Mt. Trilby; Goat Mountain in the central back ground; to its left, glimpses of the Garden-wall; to its right, Mt. Brown; farther to the right, back from the lake a number of miles, the Little Matterhorn; to the east of that, Mt. Edwards.

UPPER END OF LAKE McDONALD.

The Avalanche trail leads between Goat Mountain and Mt. Brown. Avalanche Lake, at the upper end of this trail, some twelve

miles above Hotel Glacier, is a narrow sheet of water one to two miles long, on both sides of which are found places suitable for camping. One of these, the one first reached on arriving in the Basin, is known as the Lower Camp. Another is reached by crossing at the lower end of the lake on the great raft of dead timber, which makes a natural bridge to the north side, and there passing to the upper end of the lake. This is called the Upper Camp. Here we are within a half mile of the base of Avalanche Wall, over 2,000 feet high and almost perpendicular. Down the face of this Wall fall five small streams of glacier water. But the glacier is not visible from this direction. We had been told that the top of the Wall can be reached by a natural trail on the left. But our time did not permit an attempt at finding this. And moreover our guide, Joe Rogers from Kalispell, was not familiar with this ascent.

Charles Howes, the guide who accompanied us on the other trips, insisted that an ascent to Sperry Glacier by way of Avalanche Basin is not only impracticable, but impossible. I have since learned that it has been repeatedly accomplished, and that apparently with less risk than is the climb up to the upper end of the Glacier by way of the *Rim*. At any rate he insisted on taking us to the Glacier by the way he knew, which is quite natural. In accordance with his plan we started out July 16, leaving Hotel Glacier in the forenoon. The trail leads thru deep timber around the right of Mt. Brown, across many rivulets and larger streams of clear ice water, and for several miles is not very steep. Gradually we reached a narrowing valley, and the timber receded as we passed along the steep sides of outrunners of Mt. Brown and Mt. Edwards. Behind and beneath us spread out an unbroken stretch of evergreen forest. Eight miles above Lake McDonald, at an estimated elevation above sea level of 6,500 to 7,000 feet, we pitched camp, a brush shelter against a large boulder. Two young men from Kalispell accompanied us, Mr. J. R. White, a photographer, and Mr. C. J. Holmes, a railroad man. Hardly had we finished our preparations, late in the afternoon, when it began to rain. Our provisions, bedding, collecting outfit and camera, we had "packed" on our shoulders. Of course, the shelter tent we left on the shore of Lake McDonald, confident that fair weather would be ours. Despite our implicit faith it rained steadily all next night, and all of July 17, and July 18. From a meteorological standpoint this rain was very interesting, since it was evidently melted snow,



VIEWS OF SPERRY GLACIER.

melting as it reached our lower level. This precipitation, which lasted for three days, was evidently produced by the warm, moisture-laden west winds, passing over the Coast Range from the broad Pacific and rolling within our sight up these narrow gorges. Chilled by the ice and snow in their higher levels, the vapor, at first invisible, was turned into towering cloud masses, and finally came down upon and around us as rain, slush and snow. Far above us, on the steep mountain sides, snow fell on trees, shrubs and rocks, shading into rain as it descended. Sheltering ourselves as best we could against the incessant fall of rain and slush, we kept up our courage and a good fire. Yet, in spite of all our efforts, we gradually got all wet thru. And so on the morning of July 19, when it still rained, and the wind was still from the west, we "cached" the remnant of our scant provisions—some bacon, prunes and a can of condensed milk—packed our drenched bedding, and a parcel of mosses collected during some lucid intervals on previous days, and

AVALANCHE WALL.
From Photograph by Mr. James Blake.

retraced our steps along the trail to Hotel Glacier, where we arrived at noon, a sorry looking and much bedraggled trio. Our two Kalispell friends had returned the day before. This trip is memorable also for the fresh bear-wallow, and the goat bed which we found along our trail.

The trail and basin that we had passed thru on this trip, our guide declared, had never been named. And he insisted on applying the name Holzinger's Trail, and Holzinger's Basin. Some days later, after he had had an interview with Mr. Geduhn, he stated that it suited Geduhn also, and that they would see that trail and valley were known hereafter by this name. I had no choice in the matter. And the mosses of that trip are accompanied by labels designating this valley by the above name.

After drying ourselves, resting, and taking care of the material collected, we started with Howes as guide early on July 21, across the lake to ascend Mount Trilby. I have since learned from Prof. Goode, who has also visited that region, that his guide at the time insisted on calling that peak Mt. Goode. Which leads me to suspect that some of those geographical features may have as many names as a handsome maid has lovers. And the question in either case is, which one will stick? We took along only one meal, expecting to return to our Lake camp that night. Our ascent was along the slope of Lottie Stanton facing Trilby, till we reached the gap between which the snow fields to the west were visible. Then we crossed the small stream that flows between the two peaks, stepping from boulder to boulder, and following a deer trail, made for the base of the perpendicular wall that constitutes the top of Mount Trilby. This is as far as we went up. Then we made toward the right, toward the front that faces the deep valley of Avalanche creek and Lake McDonald. On our precipitous way we crossed several "rock avalanches;" the steep mountain side is strewn in

AVALANCHE BASIN, MONT.

CAMP IN HOLZINGER'S BASIN.
From Photograph by Mr. J. R. White, taken while it rained

perpendicular streaks with jagged fragments of rock from above. When we reached the front, we realized that we stood at a giddy eminence. Far below us lay the lake, dwindled to a narrow pond. The forests of stately trees that stretched over the undulating moraines on each side of it south of the mountains, now looked like carpets of green meadows. Some twenty or more miles to the south-east the Hungry Horse Glacier glistened in the afternoon sun. Opposite us, across the gap 3,000 or more feet deep, stood Mt. Brown, behind it the Little Matterhorn, and Mt. Edwards; to the left of them, the Garden Wall, Goat Mountain and the Shepard Peaks. Between the latter and the Little Matterhorn lay stretched out Sperry Glacier, rising from the Avalanche Wall eastward, away from us, its head apparently miles beyond the peaks that rise above its surface at the eastern limit of our vision. While each step up to this point, had been rich in bryological treasures—the guide had also brought down a blue grouse for us just before we stepped out upon this thrilling panorama—here we had spread out before us geological features unsurpassed in interest. At our very feet, tho over 3,000 feet above lake level, were unmistakable traces of glaciation—rocks smoothed by the flow of an ice river; roches moutonnees, as it were, tottering at the falling-off place of this mountain side. Afterward, when we passed along Avalanche trail, I noted with great interest glaciated surfaces several thousand feet almost perpendicularly above us. But the sun was westering. And we *must* descend promptly, for we were some five miles from camp, and our trail was only such as bear and deer had prepared for us. The first 500 feet of descent was over bare rocks. The great mountain folds seem to have an almost perpendicular "dip" along our path; and the cleavage lines permitted narrow horizontal "benches" to be formed by weathering, with a very steep talus from bench to bench. This leaping down from ledge to ledge the guide designated as "dropping," a very appropriate term. I stood in constant fear that we might thus "drop" down to an impassable precipice, unable to climb up again. In fact, at one point we did have to climb up again some fifty feet to escape just this contingency; and a horrid climb it was! When at last we reached the timber, where the slope was more gentle, and where we could hang on to shrubs and trees in passing down a steep place, I breathed more easily. We reached camp after an arduous day's travel, happy, tired, and rich in finds.

LOOKING TOWARD THE RIM FROM HOLZINGER'S BASIN, UPPER CAMP.
From Photograph taken by Mr. J. R. White.

LOOKING TOWARD THE RIM, UP THE GORGE FROM HOLZINGER'S BASIN, LOWER CAMP.

From Photograph taken by Mr. J. R. White.

NOTE.—The effect of an avalanche on timber is seen in the foreground

After spending several days in the care of our collections, and in resting, we started a second time to reach Sperry Glacier by way of the "Rim." As early as the heavy dew permitted, we were on our way, again on foot. And in the afternoon of June 24th, we reinstated ourselves in our brush tent, there to spend the night previous to the final climb over the "Rim." This time we had good weather. And by nine o'clock next morning we were well on our way. Over boulders, along ledges, across small steep snow fields the guide led us, up thru the broad gorge, which he called Holzinger's Gorge. (The brush camp was in Holzinger's Basin.) My companion Mr. Blake, here had a little adventure which might have proved serious. His heavy climbing boots chafed him. So at the guide's advice he exchanged them for some large rubbers. But this made it impossible for him to get a good foothold on the firmly packed granular snowfield. One of the first fields we had to cross was very steep. We were nearly across, when to our dismay we saw Mr. Blake sliding at considerable speed down the mountain side. The guide yelled advice to him: to plant his heels, and fists, and rifle, if possible. By vigorous kicking and stamping he finally checked his involuntary descent; and with the guide's help, who hastened down to him, he soon retraced the two hundred or so feet of lost ground.

MORAINE AND FRONT OF SPERRY GLACIER.

No other accident befell us, on this climb, which at several points led us along very precipitous ledges. In that steep broad gorge from Holzinger's Basin to the Rim we counted four successive terraces some four hundred feet apart; on each of these there was a small lake, and the upper two of these lakes were at this time, the last week in July, still frozen over. Some time in the past, when the glacial ice mass was from three thousand to five thousand feet thicker than it now is, this gorge must at periods of rapid

recession have been filled with immense volumes of rushing waters forming a close succession of five or six gigantic cataracts, and the lakes seem to be purely the work of the waters upon the primeval rocks, carved out by the plunging stream.

At last we reached the "Rim." As we stood upon a narrow uncomfortably sloping ledge, which we had reached by climbing on all fours for some little distance, it seemed impossible to go a foot higher. For before us was a perpendicular wall about ten feet high. Beneath us, a precipice of some thirty feet followed by steep rip-rap and a snowfield. On the ledge, there was just room for us three The guide's request that we unload was carried out with difficulty because we were so cramped for moving space. But finally by cautious shifting we got rid of our several parcels—the guide, of knapsack with blankets and lunch; Blake, of rifle and camera; I, of collecting outfit. Then the guide began a remarkable ascent up the wall above us: hands and feet to our surprise found support in the small clefts and jagged projections. When he had reached the top, he lay on his stomach and reached down for our several parcels. When these were safely deposited on top, he had a harder task in getting us up; each hand and each foot had to come *just so,* or else we had to begin over again. Finally we stood, all three, on the "Rim," the steep wide gorge behind us, Mt. Edwards to our left, at its base a small shallow body of glacial water; to our right an unnamed peak; before us Sperry Glacier, some two miles above its base, the center of a grand panorama. We were facing north as nearly as I could make out. Obliquely to our left, northwest, stood the Shepard peaks; in the north and northeast, other unnamed peaks rose above the general mass of ice, rugged islands on a frozen sea.

CREVASSE IN SPERRY GLACIER.

The small exposed area at the Rim is well watered by numerous little glacial rivulets. By the side of one of these we sat down and ate our

lunch, before setting foot on the glacier. At last our journey down to the base of the ice stream began. I had read the stories of alpine climbers disappearing in the abyssal crevasses of glaciers, sometimes hidden by freshly fallen snow. We were traversing a field of evidently newly fallen snow, covering the deep ice sheet beneath to the depth of nearly a foot. This must have fallen during the storm that thwarted our first attempt a week before. This circumstance added not a little to my own feeling that our journey down this glacier really bordered on the foolhardy. We were not equipped with ropes; and the guide's confidence, and his assurances that he had repeatedly crossed these icy wastes when hunting the mountain goat, and that he *knew* there was no danger, availed little toward reassuring me. Yet, I kept all my fears to myself, acting upon them only to the extent of persistently following behind the guide by a rod or two—ready to check my footsteps the moment he would disappear in a hidden crevasse. Mr. Blake was innocent of all danger, and thought me needlessly timid. His sense of security gave him doubtless a much larger measure of enjoyment in these our exceptional experiences than I was able to enjoy just then.

After about an hour's journey down over the ice we reached the "front wall" of Sperry Glacier, showing at the time a perpendicular thickness of something less than two hundred feet. This front stood over half a mile back from the brink of Avalanche Wall. And this space some three miles wide, and gently sloping to the brink, is covered with small moraines interspersed with snowfields, and cut up by numerous interlacing streams of glacial water, some of them of considerable size, too deep and too rushing to be safely crossed except over the natural bridges of snow beneath which frequently lay their course. Over this distance we had little difficulty in threading our way to the brink. At last we stood at the falling-off place, at the giddy height of 2,500 feet, nearly perpendicularly above Avalanche Lake, which from this distance looked the size of a small mill-pond. To our immediate left, rising from our level now, stood the Little Matterhorn; toward our left front, Mt. Brown, in the central back ground, west of us, Mt. Trilby; to its right, Goat mountain, most bleak and precipitous of all, hiding from this point the Garden Wall; on our right, with the slopes of Mt. Brown hemming in and forming Avalanche Basin, the Shepard Peaks. We stood near the south end of the

brink; near its north end, and on a level with us, lies a small body of water, Mary Baker Lake.

But the westering sun reminded us that we must hasten to retrace our steps to the brush camp, if we did not wish to camp for the night on these chilly crags. With difficulty did I call the guide, who had discovered fresh tracks of a large mountain goat, and was following it persistently along the precipitous slope from the Little Matterhorn to Mt. Brown. Almost beyond the reach of my voice, he heeded my gesticulations only reluctantly. After I had him back, I observed with some vexation that Blake had strayed far away in the opposite direction, toward Mary Baker Lake, and was quite out of reach of my voice. He had easily crossed several of the larger streams over the snow bridges, near the base of this narrow plateau; had on the other side ascended toward the base of the glacier; and, attempting to come back, was finding some real difficulties in crossing these same streams which he had found both wide, and deep, and rapid. After some yelling and waiting he came out from behind a moraine, glad to join us for the return. This glacial plateau had proved an exceptionally interesting collecting ground, yielding the larger part of the rare and new things brought back from that trip. And while my two companions pursued their several lines of pleasure—goats and adventures—I was busy garnering my harvest.

As soon as Mr. Blake had joined us, we started back, first up the glacier to the Rim, a rather slippery way, more so apparently than had been the descent; then from there by rapid drops to the brush camp where we arrived before night fall. On this descent the guide shot for me a Rocky Mountain marmot, a large rodent, like a woodchuck but much larger, the tanned skin of which now adorns my work-room, a reminder of that hazardous visit to Sperry Glacier.

Next forenoon we arrived safely in our permanent camp on the shore of Lake McDonald. After spending two days caring for my recent collection around the glacier, we decided upon a short trip to Avalanche Basin. To this end we engaged Joe Rogers, of Kalispell, with pack horses. Several considerations urged us to make this our last trip, not the least among which was a jumping toothache. The distance of the Basin is about twelve miles. The trail, tho pronounced "good" by the guides of the region leads over very rugged stretches of moraine and ice-worn rocks.

SUMMIT LAKE AND PYRAMID VALLEY

And we were indeed glad to make at least one of our excursions astride a Rocky Mountain "burro." How slowly, and how safely these small, hardy horses carried us over this trail! Around obstructing boulders and windfalls, under and over prostrate forest trees; down and up precipitous places, fording several small but rapid streams, we reached the lower end of Avalanche lake in time to eat our dinner. This over, we made ready to reach the Upper Camp, at the upper end of the lake. To this end we had to cross over to its north shore. Making doubly sure that blankets, provisions and other trappings were securely fastened to the backs of the horses, the guide drove them to the other side of the lake outlet thru the rapids just below the great natural raft, over which one of us first crossed to head them off. From there we required more than an hour longer to reach the Upper Camp at the head of the lake. The precipitous base of the Shepard Peaks here crowds the trail so much that we repeatedly hang almost perpendicularly above the light-green water of the lake. At times it leads to the lake level across a small arm of its shallow water.

When at last the camp ground was reached Mr. Blake made a picture of our outfit before unpacking the horses. Then Joe the guide took charge of preparing the camp for the night, while Blake and I made our principal collecting trip. We ascended a dry creek bed, the rest of the mountain side, the connecting spur between Mt. Brown and the Little Matterhorn, being covered with an impenetrable growth of willows and other underbrush. Toward night-fall we returned to camp for supper. Then soon we sought the spruce bow couches, in the preparation of which Joe took especial pride; and, covering ourselves with blankets and tarpaulin, we went to sleep amid the perfume of the stately pines around us, with the canopy heaven for our only roof. Before I was fairly asleep I was aroused by a soft warm nose snuffing in my face, and a grunt

somewhat like that of a little pig. At first I hardly dared stir. But I managed to arouse Joe, who slept on the other side of Blake, to the fact that some animal was prowling around our bed. He rose up stealthily, seized a club from a near-by pile of fire-wood gathered by him in the afternoon, and with it soon laid low the slowly-moving intruder--a young porcupine. Being very tired, we were soon asleep again, only to be aroused a second time, this time by a fusilade of revolver shots from Joe, who had lain awake long enough to descry another intruder, a very large female porcupine, probably the mother of the young one killed before. This he chased and forced to climb up a small tree at the water's edge, where its outline stood clearly against the starry sky, and proved an effective target for his pop gun. These porcupines often do a good deal of damage on their night visits to the camps, by chewing up the leather straps of saddles and of harness. Otherwise they are harmless rodents. And the flesh of the young is quite a delicacy. The rest of the night we passed in peaceful slumber. The forenoon of next day we spent in exploring the steep talus at the base of Avalanche wall. Toward noon Joe had succeeded in catching the horses in the mountain pasture at the base of the Little Matterhorn, and had packed them, ready for our return to our camp at the head of Lake McDonald, which we reached safely before dark.

Two days later we were well on our way homeward on the east bound train of the Great Northern railway. Our only regret was, and is, that we could not stay two months longer, and explore regions which so far I know only from hearsay. My friend, Prof. E. R. Shepard, had told me of regions still more distant, and just as secluded and inaccessible; of Little St. Mary's Lake, reached from Holzinger's Basin, and east of it, a deep, isolated area; of Grinnell Glacier, Granite Peak, Belly Pass; and Smith Camp, and Chaney Glacier some thirty-five miles northwestward of Lake McDonald; of the Hungry Horse Glacier region, which we had espied standing on Trilby Mountain. All these regions promise materials of surpassing interest, both to the geologist and botanist. And I shall not be satisfied till some day, in the not distant future I *hope*, I can revisit this remarkable corner of our domain for a month or two in company with a small party of kindred spirits.

NOTE.—The distances and altitudes given in this paper are only estimated, and need to be established more accurately by measurements.
The cuts not otherwise credited are from photographs by Mr. E. R. Shepard.

EDITORIAL

Observational Work in Geography

Geography is the medium thru which the pupil is led into science work; and, in a way, the studies commonly known as the "natural sciences" may be called differentiated geography. In many courses of study, "Nature Study" constitutes about all the geography that is taught during the first and second years. There have been criticisms to the effect that much of the study of this sort has been badly done, that it is wasteful of time, and that the methods are often ridiculous. In many instances the charges are true. Would it be likely that a teacher with little experience in the schoolroom, no training in geography, and with the common knowledge of geography, should at first accomplish such work skillfully or successfully? Granting that the criticisms are true, it still remains a fact that the results of nature study have been distinctly good. Nature study has stimulated the faculty of observation and has taught the child to see and to discover things. For about the first time in our school work the child is ceasing to be a passive entity, into whom a certain amount of graded and useful misinformation is to be ingested; he is becoming the active factor.

With the observational, laboratory, and field work in geography, now provided in many schools, physical geography can be easily mastered in the last half of the eighth year, or even in a ten weeks' course—easily, because it is a summation of what the pupil has been preparing for in the preceding years. In other words, he acquires facts and principles in the first seven years and generalizes them in the eighth. And if the material of the political and economic geography were again taken up in the first year of the high school there would be loss of time, but there would be a tremendous gain in a practical knowledge of the world.

Book study is necessary in the last four or five years of the

grammar school course, because it is time-saving as well as labor-saving. The real training, however, must come from the observational work—the work that stimulates the pupil's activities.

J. W. R.

The Migration of a Divide

On the occasion of the opening of the great drainage canal at Chicago, which has made the Chicago river turn round and flow into the Gulf of Mexico, via the Desplaines and Illinois rivers, there has risen a neat little point on the migration of divides. One who now attempts to draw the divide limiting the basin of the Mississippi river on the east, must make a wide detour out into lake Michigan, circling around a fan shaped area of uncertain radius, focusing on the former mouth of the Chicago river. For what was once the mouth of the river has now become the outlet of the lake, and it is a sight one may witness with a thrill, to watch the earnest gulfward flow of the river, which has been so long a vile and stagnant pool. For there is now a very marked current, and a strong protest goes up from the pilots and barge men, who have never before had a current to contend with. Several times already a long freight boat has drifted round in the current and lodged crosswise in the narrow stream. Then the great bear-trap dam at Lockport must be closed up, and the flow stopped before the boat may be extricated.

It will be a long time, it may be years, before the filthy river will have become a healthy stream, and before the water of the lake will have become freed from the filth the sewers have been carrying into it so long, so that it will be beyond reproach for household use. And all the while the water which is going over the Lockport dam is furnishing 30,000 horsepower of energy to add to the manufacturing advantages of the great city.

J. P. G.

The Wonders of Modern Navigation

In the early part of July the Hamburg-American Line steamer Deutschland crossed the Atlantic with 1,400 passengers and 15,000 tons of assorted freight. The magnitude of these figures is well calculated to arouse the interest of every one. At the same time it exhibits the vastness of modern industrial processes.

With the crew of the ship, nearly if not altogether two thousand people were on board. All these were comfortably housed, fed, and provided with all the necessities and most of the luxuries of modern life. We can realize what the figures mean better perhaps by a comparison. A borough containing two thousand people will require several hundred houses and cover an area perhaps of half of a square mile. Then think of the wonderful cargo of freight that came on the ship with this big town of people! Think of five hundred cars each carrying thirty tons of freight! That would make a long string of cars and would have to be cut up into a good many trains.

If we pause long enough to contrast this splendid example of modern marine architecture with the ships that carried the first navigators across the Atlantic, or even those which brought the Puritans to Massachusetts or the Quakers to Pennsylvania, we will find that she carried as much freight as a fleet of seventy-five average ships of that day did. The world's progress has few greater marvels to record within the past two hundred years than this advance in the art of shipbuilding and man's conquest of the ocean.

H. J. R.

Suggestions to Teachers

It is well at the beginning of the year for each teacher of geography to make some test of his previous work. A most efficacious way to do this is to ask the following test questions: "Do my children enjoy the study of geography more and more the longer they remain in my room?" "Do they wish for more time to be given to it?" "Am I improving in my teaching of the subject?" "Am I taking and reading one or two geographical magazines?" "Do I generally read a book of travel upon the country which I am teaching?" "Am I doing some field work with my children?" "Do I make careful preparation for each lesson?" "Are my pupils learning to love the reading of books of travel?" "Do I feel above and free from the text-book?" If, my friend, you can answer "yes" to such questions as these you are to be congratulated and your pupils also. If you must say "no" to most of these inquiries then there is great room for improvement, and may the coming year bring it about and the joy thereof.

The many books, magazines and newspaper articles upon South Africa and China recently published, offer to wide-awake teachers

plenty of material for acquiring needed information upon these distant parts of the world. Why not spend in the coming year a little extra time upon these countries? *Innermost Asia* by R. P. Cobbold, is one of the recent books dealing with the human and animal life of the Pamirs. It also touches upon the action of Russia in regard to her frontiers. The writer believes that the policy of Russia is always to advance, and that she will soon annex Northern Afghanistan and advance into Central Asia still farther.

More interest will be awakened if teachers of geography will take up some new subject or a new country at the beginning of the year's work, instead of spending weeks in reviews which should come later in the year.

Study the action of water upon the surface of the earth by out-door observation with the class, after a downpour of rain. Then illustrate in the school-room by pouring water from the sprinkling pot or hose upon the moulded sand.

The latest geographical publication, and one of the best, is issued in three volumes, the size and shape of a fourth reader. Part I is Home Geography; part II, North America and the United States; part III, the other grand divisions. The authors are Professors Tarr and McMurry. The publishers are the Macmillan Co., New York. The first and second books are already out, and teachers are advised to examine these volumes as there are many new and most interesting features in them.

Happy is that class or school which has for its teacher an amateur photographer, who has been spending during the past summer both time and money in obtaining good pictures to use in illustrating geography. I know one man who has taken over fifty photographs of rivers, brooks, hills, mountains, valleys, and other scenes in nature, and which he will turn into slides during the coming autumn for the benefit of his pupils.

One of the best aids to good teaching of geography is a large scrap-book filled with cuttings from newspapers and magazines. Divide the book into three parts; viz., 1. Illustrations. 2. Interesting facts. 3. Methods and devices.

Do not be ashamed to tell your children about your summer travels.

Aim first and daily to interest your children in the subject under consideration. What have you been reading this summer to help you in your work?

Now is the best time for out-door lessons while the climate is so favorable in September and October.

Helps, apparatus, devices, illustrations and books are now so abundant and so good that there is no excuse for poor teaching in geography.

What a wealth of good things were put between the covers of Bulletin No. 2! K.

REVIEWS

Taschen-Atlas. — By Hermann Habenicht; 16mo., 1899. M.2.40. Justus Perthes, Gotha, Germany.

Every teacher of geography or lover of fine maps will be glad to know of a series of little atlases issued by the well known house of Justus Perthes. They are just the right size for the pocket and are marvels of neatness and completeness. There are at present five volumes in the series, and they sell at about M.2.40 net apiece.

One of the most valuable in the series is the Taschen-Atlas (Pocket-Atlas), of which some account will be given. The others will be more fully mentioned in a later issue.

The Taschen-Atlas is a neat little volume in green cloth, 4⅛ by 6⅞ inches, and about ⅜ inch thick. It has twenty-four two-page maps by the famous geographer Habenicht. The maps are copper engravings most exquisitely printed. The finest quality of plate paper is used, and the workmanship puts to blush anything of the kind ever brought out in this country. For fineness of line, accuracy of detail, mass of data entered, and beauty of coloring they are unsurpassed.

There are charts of the world to show relief and ocean currents, and full page maps of all the continents. Then there are full page maps of various countries, those of the British Isles, France, Italy, and Spain being especially fine. There are three full double page maps of the German empire. In all these cases, as also in the case of India, the Orient, and Middle America, the maps are far superior to anything we have ever had in any of our best school geographies.

Add to this wealth of maps, sixty pages of geographic statistics and information on area, hights and depths, populations, armies and navies, and commercial activities of all the countries, and sell the whole book in this country in spite of the tariff at 60 cents, and all educated people may be glad there is a Germany, to make such things possible. The only drawback about this little atlas is that it is in the German language, and there is as yet no edition issued in English. J. P. G.

HEAD OF CHESAPEAKE BAY FROM ELK NECK.

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SOME PEDAGOGICAL PRINCIPLES UNDERLYING THE TEACHING OF GEOGRAPHY

BY ARTHUR ALLIN, UNIVERSITY OF COLORADO, BOULDER, COL.

Education has often been defined as self-expression, self-realization, or training for complete living. It has been defined as a drawing-out process (e-ducation), an evolving of the self, a self-expression. Training in individuality is undoubtedly an excellent thing under certain circumstances. Much of our natural character, however, should not be trained, as educated society would consider it detrimental to its best interest. Some instincts are anachronistic and hence harmful.

What then is education? We may leave the realm of arbitrary opinion by seeking the historical answer. Education is a process much older than man. With the eye of the natural historian and geographer we may watch the first piscatorial attempts at adjustment to the environment, the wild, incessant struggle for existence, the "giant ichthyosaurus splashing in Jurassic oceans", the sabre-tooth lion competing with the squalid but sturdy cave-men, the bloody battles of the early savages down to the military monarchies of today fighting for a world-market. In all this long struggle selfishness seems pre-eminent, and Nature seems "red in tooth and claw". The laws of Malthus seem omnipresent, food tending to increase in arithmetical progression and population tending to increase in geometrical progression. The struggle for food in history! What volumes are yet to be written!

Thus it seems at first glance. But there is a far deeper view, one ascertainable and readable in the history of the past. The instincts are, especially in the lower animals, the fundamental characteristics transmitted by organic heredity. They are the grand trunk line of transmission and continuity. Now the instincts are peculiar in this way. They are always in their origin and bloom for the benefit of the *species* to which the animal belongs. They are of benefit to the individual only secondarily, in as far as that individual may be of benefit to the species to which it belongs. The mother gives up her life for her child. She dies but her instinctive action is good for the benefit of the larger number. Instincts are always for species or race preservation. They are specific, altruistic, other-regarding, profoundly social. They may not all be consciously such. But in their final purport they are always, in their origin and bloom, intensely social.

The acquired characteristics, as distinguished from the inherited, are similar to the organic, in that they are again profoundly specific, altruistic and social. Only those species, races and societies persist whose actions, instinctive and acquired, are for the benefit of the species. Selfishness in the larger sense is the performance of actions detrimental to the species, race or society. As such it cannot persist. An instinct of suicide, for example, is impossible. Thus altho the historical retrospect seems at first sight selfishness incarnate, nevertheless the process is decidedly and certainly altruistic and social.

The educational process has then always been *a training for public or social service*, a training for the common weal or commonwealth. Individuality and self-expression decidedly—if for the general good. Our educational aims have been, however, unduly individualistic and selfish. Acquisition, personal acquisition without end and but little social practice. Communal effort and conduct has been at a minimum. Help from one student to another is often regarded as a pedagogical crime. I trace much of our immorality in commerce and politics to the deep ingrained selfishness implanted by our school methods in early youth. Geography, as well as other subjects, must be taught socially.

If education is training for public service, then our young cadets in training for society must be equipped for social service. They must acquire the social heritage of the race, they must come up to the level of adult society if they are to be helpful partners or

socii of that society. Three factors enter into this social heritage: Technic, the Laws of Nature and the Laws of Human Action. (*1*) *By means of extra-organic instruments man as an individual multiplies his strength indefinitely;* (*2*) *by knowing and uniting himself with the powers of nature he becomes as strong as nature itself;* (*3*) *by knowing and co-operating with the laws of the social organism* (*human society*) *he acquires the strength of and manipulates the whole organism.*

There are more than 310 mechanical movements known to mechanics today, and all of these are but modifications of those found in the human body. Here are found all the bars, levers, joints, pulleys, pumps, pipes, wheels and axles, ball-and-socket movements, beams, girders, trusses, buffers, arches, columns, cables, and supports known to science. At every point man's best mechanical work can be shown to be but adaptations and extensions of processes of the human body. Organic evolution is continued in extra-organic evolution. The human body has practically ceased developing. In fact one of the main reasons for our present rate of development is the fact that the body is becoming more helpless and plastic. The nine billion nerve cells of the brain are now so plastic and indefinite in their functions at birth that they can be united in habits of almost indefinite extent. They can acquire the social heritage. The lower animals are limited in this respect, because of the definiteness of their inherited brain structure and function. Their instincts are their limitations. Instincts have become with us largely impulses, desires, incipient tendencies. The brain of man thus allows him to extend his organs. As his sense and motor organs are tools and instruments so the extensions are but tools and instruments of his organism. They are a part of him while he is using them. The hammer, chisel, crowbar, telescope, microscope, thermometer, trap, weapon, the knife, etc., are extensions of our organs. Fire is a predigestive organ, the book an extra-organic brain-registering apparatus, etc., etc.

There is a supreme necessity of dominating as soon as possible the external and internal worlds. The home and the school are the social media for such training in world-compelling and world-dominating technic. Manual training must be extended much farther to meet the demands made by society in the matter of technic. The constructive work of the Chicago schools is an effort along this line. At present the aim of manual training is largely individualistic, the

training of the motor side of our nature. The teacher in geography will have to work out many problems here. The education of the race has been along these lines, a steady growth; with many short-cuts and with proper suggestions our young social cadets should follow the growth of technic in the world's history. Since the world learned and made use of technic in an occupational life, where tools had a social use and were means toward ends, so the child may with benefit do the same. At present the subjects of our curriculum are ends in themselves rather than means towards social ends. To this is due the lack of interest, motives, or motor power.

Much can be learned from history. Here we see human development arising in the arts, or in the use of technic which is essentially collective and social in character. Each individual thru technic becomes subordinated and dependent upon other individuals. Society is integrated or organized thru technic. Integration of parts means the connected play of them; so that one being affected the rest are affected. Differentiation from other organisms means individuality and arises from division of labor; integration is sociality and differentiation is a condition of the integration. As the arts increase organization increases, and as organizations grow definite, custom, law and habit develop into institutions, the highest products of human development. Thus thru technic or the arts we have in history the growth of organization, institutions, culture and civilization. The progress of the pupil in school can well follow such a process if thereby he can become human, social, a member of society.

Much might be said on the second and third divisions, but I shall confine myself to only one part of the subject. All the extra-organic tools and instruments which have survived in the social struggle for existence are characterized by the fact that besides being social and specific in their nature they have been economizers of time and labor. If an invention does not save time and labor it does not persist in the competitive struggle. Language is such a contrivance. With untold labor the race has accumulated a vast amount of knowledge of the material and of the human social worlds. Language preserves the accumulation and obviates the necessity of a repetition of the labor. The knowledge is transmitted from generation to generation by oral and written tradition. More time and labor is saved by gathering this knowledge into the form of laws. This is largely the scientist's justification for exist-

ence as a scientist. A uniformity of actions (habit) is observed in a multitude of objects; this uniformity is expressed in words or in a single word as for example, gravitation. By the use of the word designating such uniformity of action there is a saving of time and labor in enumerating the particulars. Such laws or terms denoting such laws are a sort of mental short-hand. The same is true in classifying similar objects Instead of enumerating all the different objects, say minerals, we have coined a word which will call up by association of ideas, when there is need for such, a large number of such similar objects. Thus one of the principal tasks of science is to economize time and labor by the discovery and enunciation of laws or concepts. These concepts are a sort of *algebra* where the symbols used are abstract in the sense that x, y or z are symbols for concrete cases. The scientist is searching after new facts it is true, but I take it that his main task is the search for laws.

Here arises an imminent danger in the educational world and one from which we are just beginning to break away. A concept (a universal or abstract idea) is usually regarded as a word or concrete presentation which may call up by association of ideas a number of similar actions or objects. This is only a partial truth. A concept is much more. If that were all we should still remain in the world of intellectualism in which we are now pedagogically living.

In first winning or learning a concept or law we employ the senses in the acquisition of information. Concrete objects and actions are examined in many ways, sensations are grouped into perceptions, and percepts grouped into concepts and laws. The motor nerves and the musculature are busily engaged acquiring the additional information, manipulating objects and adjusting our organisms to the objects or actions concerned. Muscular, glandular, vascular, neural and metabolic processes are all engaged in the winning of a concept. From infant activities to those activities of adults in which nations go down in blood and ruin fighting for freedom, there are involved all the activities of the human organism. Take the concept of liberty for instance. This concept has been learned in many a dungeon cell, on many a battlefield, in many a ruined and smoking home, in tears of joy, despair and indescribable grief, In a world of anticipations, hopes, disappointments, rebuffs and struggles the concept of liberty has been attained. The Arian-

Athanasian struggle about the concept of the procession of the Son from the Father devastated Northern Africa, rent kingdoms and destroyed an untold number of lives and homes.

Thus the intellectual side of a concept is only a part of it. In the building and the winning of concepts the physiological and the psychical are parts of one whole. The concept is made up of an organic unity of physiological and psychical action potential and actually present. They are not separate so far as function is concerned. It is an organic unity. Thus the concept, liberty, meant to those who earned it infinitely more than what it does to us. The word to them called up by association not only certain intellectual elements but also a world of motor reactions, and a multitude of glandular, vascular and metabolic reactions. To you and me the word does not call up the same reactions. To us it is largely a symbol, a word and little more. Practically we do not possess the concept.

The significance and utility of a concept lie chiefly on the motor side and it is precisely that side which has been most neglected. The motor as well as the mental side is trained and acquired in the learning of a concept. A thoroly well learned concept will thus be a word, symbol or the presentation of a concrete object or action which may call up by association not only ideas of similar objects and actions but also certain definite motor reactions. These latter are, as before mentioned, muscular, glandular, vascular and metabolic in character. "Association of ideas" is a miserably inadequate phrase for an activity embracing the organic unity of ideas, feelings, and the myriad-fold combinations of physical reactions.

"A chemist *is able* to recognize a piece of sodium at sight, but does so on the presupposition that a definite number of tests which he clearly has in mind will unfailingly give the results which he expects. He can apply the concept "sodium" to the body in question with *certainty* only provided he actually finds the same to be soft as wax and easily cut, to have a silver sheen on the cut surface, to tarnish readily, to have the capacity to float and to rapidly decompose water, to have the specific gravity 0.972, to burn with a yellow flame when ignited, to have the atomic weight 23, and so on. The concept "sodium", accordingly is merely the aggregate of a certain series of *sensory attributes* which make their appearance upon the performance of certain *definite* manual, instrumental, and

technical operations, considerably complicated in character. * * * The definition of the concept, or the name of the concept, disengages a definite activity, a definite reaction which has a definite result. The manner of the reaction, as well as of the result, must find its expression in consciousness, and both are characteristic of the concept. * * * Inasmuch, therefore, as the group of operations which is involved in the employment of a concept is frequently complicated in character, it is not at all remarkable that the result of the same should be set forth before us as a visual picture only in the simplest cases. *It is furthermore clear that the group of operations in question, like the movements of our body, must be thoroly practiced if we are really to possess the concept.* A concept cannot be passively assimilated; it can be acquired only by doing, only by concrete experience in the domain to which it belongs. One does not become a piano player, a mathematician, or a chemist, by looking on; one becomes such, only after constant practice of the operations involved. When practice has been acquired, however, the word which characterizes the concept has an entirely different sound for us from formerly. The impulses to activity which are latent in it, even when they do not come to conscious expression, or do not appear in consciousness, still play the part of secret advisers which induce the right associations and assure the correct use of the word." [1]

Language enables us to save time and labor it is true, but we must remember that much of the so-called knowledge we take on faith thru the instrumentality of language is pseudo-knowledge. It is faith without works, dead. Much we may take on faith, much we must needs take to keep in step with the accelerated tempo of modern life, much again we take on second-hand information under the mistaken impression that it is real knowledge. The pupil in school to really learn these concepts and laws handed down to us from past generations, must again lead the strenuous life of our predecessors, but with short-cuts and suggestions. Until he has learned the *whole* concept, with its varied reactions he is rather a *use-less* member of society. For society demands *useful* members, men of action and conduct rather than men of knowledge. The knowledge is only an instrument for action.

Excessive Lesson-learning may develop into an acquired dis-

[1] Mach, The Concept, Open Court, June, 1900, pp. 350 and 352. Translated from Mach's *Waermelehre* by T. J. McCormack.

ease. The pupils may become neither inquisitive nor acquisitive. They may have little if any power of helping themselves, little desire to learn about things, little if any observing ability, little desire to reason on what they see or are called on to witness. They must be taught to do and to appreciate. Facts and their use must be learned at the same time. They must be led to discover facts for themselves. Instead of placing condensed summaries in their hands, we must lead them to consult nature itself, use works of reference and acquire the habit of finding out; they must always be at work applying their knowledge and solving problems. We must not only teach science, but teach scientifically. Otherwise our pupils will suffer atrophy thru lack of exercise. The school should be a workshop. Research should be its atmosphere; the useful citizen its product. Research, however, should not be confounded with original research.

It is thus that the laboratory method, using the term in its wider sense, must be practiced in the acquisition of the social heritage. The student will then be trained to use his knowledge in society. Knowledge will not be divorced from action. It may bear repeating that, *By knowledge and practice of extra-organic instruments man as an individual multiplies his strength almost indefinitely; by knowing and acting with the powers of nature he may become as strong as nature itself; by knowing and coöperating with the laws of the social organism he may acquire the strength of and manipulate the whole social organism.*

PICTURES IN THE TEACHING OF GEOGRAPHY

BY JOHN A. WOOD, SUPERINTENDENT OF SCHOOLS, LA PORTE, IND.

I now require this of all pictures, that they domesticate me, not that they dazzle me.—Emerson.

A careful examination of our memory forms will show that the visual image occurs much more frequently than any other memory image and will lead us to accept the testimony of recent investigators that on an average two persons out of every three are eye-minded; i. e., they perceive, reproduce and think in terms of visual images. The recognition of this eyemindedness of people gives rise to the present day multiplicity of pictorial illustration in the advertising posters, circulars, newspapers, magazines, pamphlets and books. These illustrations render to the observer, often at a glance, a whole story and make such an impression that the advertiser finds pictorial advertising highly profitable. Who has not felt the force and power of the cartoonist as he so adequately and completely describes a situation or an event? These cartoons as well as real works of art make vivid impressions and enable one to arrive at a definite idea of the artist's conception with the least possible expenditure of time and effort in interpretation.

It is this economy of time and energy in gaining clear and distinct ideas of objects and their relations that makes pictures so valuable an aid in school work and in life in general. Much might be said of the value of picture study in general,—much has been said about Art in the Public Schools--but it is in no wise the purpose of this paper to discuss pictures from the ornamental or artistic phases, but merely to discuss pictures as related to their serviceability in Geography.

The purpose of geographical study is to gain, as far as possible, a complete and intimately related knowledge of a part or of the whole of the earth as related to man, his environment or his occupations. This purpose determines very largely the subject matter of pictures appropriate to geographical study. The range of sub-

jects is comprehensive and the forms of execution are manifold—varying from the rough crayon and pencil sketches, drawn in the presence of the class, to prints, paintings and etchings of the highest technical and artistic merit.

The principal business of the primary school in geography is to collect the largest possible fund of related or relatable facts for the synthetic processes in the organization of geographical knowledge in the grammar grades. Hence the value of pictures which will help the child to develop, thru a cultivated imagination, concepts of distant scenes. "Children have very clear mental pictures of the homes in which they live and of the scenery that surrounds them—these objects they can describe from their mental images. By the relating of stories (and by the use of pictures) it is easy to lead them to imagine scenes and landscapes that lie beyond their sense-grasp."—Parker.

The novelist understands the power of word pictures and so places his readers at pleasure in mountains, valleys, or plains and moulds the landscape at his will. The teacher thru judicious use of geographical pictures can also mould the imaginations of the child so that he may have the appropriate geographical concepts for those geographical features beyond the reach of the child's immediate observations. In this way the child gains accurate knowledge of practical value in regard to political, physical, and commercial geography. The judicious selection of pictures and the proper adaptation of them to the varying mental abilities of the children is a task of immense responsibility, for, like many good things, pictures may be used and presented so as to be a hindrance to mental progress by producing hazy and confused ideas of the objects represented. At no time should the child be overwhelmed by a great number of pictures upon different subjects, and only when he has acquired a good power of reading pictures should he be given a great variety upon any particular subject. For beginners, pictures should be selected that are diagrammatic rather than picturesque and every new element in the picture should be carefully developed so that the child can make no error in reading pictures having similar elements. At this stage the teacher's simple blackboard sketches will prove especially effective, tho their use is never to be neglected. With beginners pictures should be of land or water forms, localities, buildings or industries with which the child is familiar, so that he may the more readily comprehend the

pictorial elements. From these simple beginnings the child can soon pass to the more complete pictures and may begin his own collection.

Pictures which show extended areas of land and water forms and show the relations of these to the products and industries of that region are of great geographical value. By careful collecting it often would be possible to show the successive stages in the growth of natural products, or the steps in the transformation of natural products into articles of trade and manufacture as these changes occur in different sections

Collections of pictures for illuminating maps to show distribution of men, characteristic animals, plants, natural products and industries make valuable aids in commercial geography. Collections showing the natural environments, social customs, home-life, costumes, occupations, etc., of people in different countries will greatly extend the child's interests in and knowledge of geography. All of these collections will be of service in language work, story writing, history and nature study, and will form, if carefully directed, an important correlative link with the subjects just named.

No small part of the pedagogical value of these collections comes from the process of collecting and arranging the material; hence teachers should be ready to suggest to the children sources from which to obtain pictures and to suggest plans for arranging, mounting and filing pictures. They should also direct the arrangement of the school collection so that it may become an integral part of the school library of pictures. The children should be encouraged to make individual collections and should be given simple directions for the preservation, arrangement and classification of their collections.

In collecting the child gains opportunity for extended observation of pictures, and cultivates a power of discrimination as to the merits of the picture. In his scheme of classification he must read his pictures intelligently and so analyze them that he may place each in the group to which it belongs. Such placing calls for a considerable exercise of memory and also requires more or less comparative examination of the group, from which there arises in the mind of the child a more general and a more accurate conception of the objects illustrated by the groups. In the trimming of his pictures and in the process of mounting them the child gai nsa

considerable exercise in manual work, leading to coördination of hand and eye, to judgment, to appropriate æsthetic arrangement, and to neatness and accuracy in execution.

Besides the benefits named above that come to the child from collecting his pictures there comes a social interest that is of utmost importance. His pictures appeal to those of his family and circle of intimate acquaintances who have an opportunity of examining his collection; and so the collection becomes a center of mutual interest, incidentally teaching others and drawing from them descriptions of places or scenes suggested by the pictures. This will add materially to the significance of the child's collection, and the interest on the part of others will lead them to become contributors to the collection and so enrich it. This social interest is what makes the school collection, in the hands of a skillful teacher, so powerful and incentive to the children and to the community.

Experience has proved that the greatest difficulty in the use of pictures as aids in teaching Geography or indeed in teaching other subjects, even of Art itself, is not in lack of material, but in lack of a suitable scheme of arrangement and preservation of the material which pours in upon the collectors. As a rule these illustrations are clippings from the fugitive literature of the time—daily papers, magazines and advertising sheets—and need to be reinforced by some light but substantial material if the pictures are to be subject to any general usage in the school or community. In my own work with pictures I have tried various experiments in arranging and mounting pictures so as to have them most available for use in different lines of work and in different places when wanted.

Classifying pictures by placing them in large envelopes which are clearly labeled and placed according to general index makes the material most available for the individual collector and leaves the pictures free for any special arrangement in line of the topic under discussion in the various subjects of school instruction.

For school or library collections I believe an encyclopedic envelope file having envelopes labeled and arranged with topics in dictionary order proves most serviceable, and, after first cost of filing cabinet, is by far most economical in time and money. Such a file is ordinarily too cumbersome and too expensive for individual collectors, hence the resort to the envelope scheme where but few headings are made and which leaves the matter so hard to find after

it has been placed that the collection becomes practically valueless.

No collection of pictures, however fine, is worthy the name of an illustrative aid, if it cannot be added to in closely classified arrangement, easily and quickly, and if it be not so indexed or cataloged that the pictures desired can be found at once.

The filing of pictures in consecutive order as indexed is not the best arrangement, for such an order renders it necessary to turn thru the entire collection in order to find the material illustrating a given topic. Arranging pictures in somewhat closely classified order and numbering them by the hundred for the groups and by the tens and tenths for subdivisions will give a fairly convenient and workable arrangement of pictures. In fact, such a numbering and grouping as is suggested for books in the Dewey Decimal System for Library classification can be well followed by school and library collectors; and for private collectors a simplified form of the same system is very efficient.

The scrapbook system of collecting has many points in its favor—among these are the following: 1. The books preserve the pictures better. 2. Permanent arrangement into groups is secured. 3. By indexing, classified additions are easily made, and with pictures explanatory descriptions, etc., can be permanently attached. 4. Because of their compactness the collections are easily transported. Some objections to the scrapbook are: 1. The necessary limitation of illustrative material upon a given topic to one or two who can examine the book. 2. The confusion and dissipation arising in the children's minds by trying to comprehend many pictures illustrating the type desired instead of holding long enough to one to have it thoroly perceived and retained. 3. The inability to rearrange groups or individuals in groups because of the fixity of the pages.

Many of the advantages of the scrapbook plan can be preserved and many of the objections removed by mounting the pictures, grouped under subject headings, on large cardboard or paper sheets, which sheets shall be left unbound, but numbered so as to render general indexing possible. The large sheets or the individual pictures furnish the most convenient forms for placing before the children, as they can be easily pinned to the molding strips or ledges run for that purpose and be left until they have served their purpose when they are easily removed and returned to their proper places in the collection.

Whatever the plan of the collector may be, let it be remembered that no collection is worth anything educationally that is not well classified and indexed.

A helpful and suggestive list of sources of geographical pictures is given in King's Methods and Aids in Geography pages 251-253. Another list, which emphasizes the artistic as well as geographical phases, is found in Emery's "How to Enjoy Pictures, pages 272-273. This list is intended especially for wall decoration. Fine selections for geographical aids may be made from reproductions of the Perry Pictures Company's list, also from the reprints of the Brown Company. The Saturday and Sunday city dailies give many illustrated articles that properly belong to the geographical scrapbook and picture collections. One of the most striking features of the modern popular magazine is its wealth of illustration. Here the collector may find a veritable mine of resources. Many and varied illustrations may be gathered from the advertising pamphlets of the various railroad, steamboat, excursion, summer resort, and land improvement companies, as well as from the advertising sheets of various manufacturing and commercial concerns who will gladly contribute the material for such advertising as they may secure by the use of their pictures in the school, and who will charge nothing but postage or expressage to cover cost of transportation. The recent editions of geography texts and geographical readers abound in fine models for the style of pictures most desirable.

Where a school can afford it, the stereopticon furnishes the ideal method of use of pictures in the conduct of occasional lecture recitations in geography. The picture on the screen affords an opportunity for unity of effort on the part of the class, together with the interest that makes lasting impressions in very short time. The stereopticon work affords the teacher a most excellent chance for developing the relations of the various geographical elements in the picture, and thus secures a logical geographical sense.

The very general use of the kodak in all parts of the world, with the fine opportunities for exchange of views thru the agency of the American Bureau of Geography, extends the opportunity of collecting pictures showing local characteristics of different sections, thereby vastly enriching the child's information of remote geographical conditions, and in a concrete way laying a foundation for intelligent work in commercial geography.

Teach the child early to know good pictures from an artistic standpoint, and permit no geographical pictures to be used on the walls for permanent decorative purposes that are not the very best art products that the school can afford.

No attempt will be made in this paper to present in detail any specific method of using pictures in recitations, any *teacher* is able to work this out to suit the class and subject to be presented. Enough has been said, perhaps, to show the service that pictures may render in the teaching of geography; and much that has been said of geographical pictures applies with equal force to pictorial work in other lines of school subjects. In fact the geographical collection because of its many sided interests forms a most natural correlating link with other subjects.

Since the days of Comenius and his "Orbis Pictus" the idea of teaching by pictures has not been new, but I would not go as far in some respects as did Comenius in his advocacy of pictures. From the emphasis given above to picture work there is danger of some misunderstanding as to the amount of time and effort to be given to teaching by pictures. I would by no means permit pictures to take a large amount of time in the school treatment of any branch of study. I consider pictures merely illustrative material; and that should never form a major part of a course where children are to be developed in powers of thought and action. I grant that pictures do arouse intense enthusiasm for a time; they do secure coöperation and interest of the child, and trick the child into knowledge while being entertained—still there is danger thru excessive use of pictures of losing in the child the habit of serious work and an attitude of strenuousness even in geography that makes for moral strength; he also loses the habit of organization and reflection that develops independent power of thought and initiative.

Picture teaching, if excessive or poorly directed, distracts and dissipates the child's energies by the diversity of subject matter and the multiplicity of details; it begets the skimming habit of acquisition; leads to vague generalities instead of definite knowledge, and wears out teacher and pupil by the mass of material poured in upon them for consideration.

If this paper proves somewhat suggestive as to how pictures may be collected, arranged and occasionally used as an aid in the teaching of geography its whole purpose is accomplished.

THE SIGNIFICANCE AND IMPORTANCE OF GEOGRAPHICAL NAMES.

BY WM. W. RUPERT, SUPERINTENDENT OF SCHOOLS, POTTSTOWN, PA.

"What's in a name? that which we call a rose,
By any other name would smell as sweet;
So Romeo would, were he not Romeo called."

Juliet's argument sounds well, and we are willing to admit that, for the particular case to which she applied it, her logic is faultless. It would certainly be un-Shakespearian to hint at a different conclusion.

From the standpoint of geography, however, we are certain there is much of significance and importance in even a name. As leaves and flowers are wrapped up in buds, or as fossil plants and animals are found in the rocks of past ages, so poetry and history are hidden in geographical names.

A search for these concealed meanings will well repay any teacher of geography. Geography and history are thus united by another bond and each subject is enriched thereby. While the geographies recently published are superior to the older books, there is one particular in which they are inferior. Very few, if any of them, contain an etymological vocabulary of geographical names.

Trench in his famous work on words most truthfully says, "Many a man has gazed, we are sure, at the jagged and indented mountain ridges of Spain before one called them 'sierras' or 'saws', the name by which now they are known, as Sierra Morena, Sierra Nevada; but that man coined his imagination into a word which will endure as long as the everlasting hills which he named."

What a pleasing revelation it must be to a boy or girl in the geography class to learn that Sierra Morena means the "Brown Saw", and that Sierra Nevada means the "Snowy Saw". The poetry in the idea excites, strengthens, and elevates the imagination, and tends to intensify and purify thought.

Iztaccihuatl is a word of forbidding aspect, but there is really more poetry in it than is found in sierra. The summit of this extinct volcano is covered with snow and ice. To the mind of some poetical person the outline of the snowy summit suggested the form of a woman in a recumbent position. Head, trunk, and limbs are to-day pointed out to the traveler who visits this famous mountain. The poetry concealed in Iztaccihuatl lies in the fact that the word means the "White Woman".

It is very easy to forget that geographical names had once a peculiar fitness, which was the occasion of their giving. "Color", says Trench, "has often suggested the name, as in the well-known instance of our own 'Albion'—'the silver-coated isle' as Tennyson has so beautifully called it,—which had this name from the white line of cliffs that it presents to those approaching it".

Very striking as the embodiment of a poetical feeling, is the modern name of the southern peninsula of Greece. "We are all aware," remarks Dr. Trench, "that it is called the Morea, but we may not be so well aware from whence that name is derived. It had long been the fashion among ancient geographers to compare the shape of this region to a plantain leaf; and a glance at the map will show that the general outline of that leaf, with its sharply-incised edges, justified the comparison. This, however, had remained merely as a comparison; but at the shifting and changing of names which went with the breaking up of the old Greek and Roman civilization, the resemblance of this region to a leaf, not any longer a plantain, but a mulberry leaf, appeared so strong, that it exchanged its classic name of Peloponnesus for Morea, which embodied men's sense of this resemblance, for *morea* is the Greek for mulberry tree."

Enough has been said, perhaps, to show what Emerson meant when he said, "Language is fossil poetry." Before we shall have concluded it will also become clear, we think, why Trench mildly criticised Emerson's statement, saying that language may be, and indeed is, "fossil poetry;" but it may be affirmed of it with exactly the same truth that it is fossil ethics or fossil history.

In imagination let us return to that famous year in which our own continent was discovered. "The deep religious feeling," says Isaac Taylor in his delightful book on words and places, "of the early voyagers is well illustrated by the names which they bestowed upon their discoveries. The first land descried by Columbus was

the island of San Salvador. From day to day he held on, in spite of the threats of his mutinous crew, who threatened to throw the crazy visionary into the sea. With what vividness does this name of San Salvador disclose the feelings with which, on the seventieth night of the dreary voyage, the brave Genoese caught sight of what seemed to be a light gleaming on some distant shore; how vividly does that name enable us to realize the scene when, on the next day, with a humble and grateful pride, he set foot upon the New World of which he had dreamed from his boyhood, and having erected the symbol of the Christian faith and knelt before it, he rose from his knees and proclaimed, in a broken voice, that the land should henceforth bear the name of San Salvador—the Holy Savior, who had preserved him thru so many perils."

On his third voyage in 1498, Columbus saw three mountain peaks rising from the ocean and at once supposed he had discovered three new islands. On nearer approach, however, it was seen that the three peaks arose from the same island, and in this fact the great navigator saw a mysterious emblem of the Holy Trinity. He, therefore, called the island La Trinidad, a name which it retains to this day. This name, indeed, has received a wider application than the pious Columbus ever intended. Some of us can remember the delicious ginger cakes our mothers made from Trinidad molasses.

St. Kitts or St. Christopher is, you know, a saint of the Roman Catholic Church, but why should Columbus name an island of the West Indies after him? Well, in art, St. Christopher is, you will remember, represented as of gigantic stature, and usually as crossing a river with the child Jesus on his shoulder. You may recall that Longfellow in his poem, "The Lighthouse," says,

> "Like the great giant Christopher it stands
> Upon the brink of the tempestuous wave,
> Wading far out among the rocks and sands,
> The night-o'ertaken mariner to save."

Now, the huge mountain mass of St. Kitts bears upon its shoulder a pyramid of black lava; and this mountain bearing the little patch of lava, took, in the fervid imagination of Columbus, the form of the giant St. Christopher carrying on his shoulder the infant Christ.

Santa Cruz (the sacred cross), Vera Cruz (the true cross), St. Anthony, San Domingo (holy Sabbath), San Francisco (St. Fran-

cis), San Lucas (St. Luke), Santa Fe (holy faith), St. Lawrence, and scores of other names upon the map of the North American continent bear indisputable testimony to the romantic piety of the fierce soldiers and navigators who, four centuries ago, came to the shores of the New World.

"France," says Parkman, "was the true pioneer of the Great West. Those who bore the fleur-de-lis were always in the van, patient, daring, indomitable." And foremost in this bright array of forest chivalry is the bold Norman adventurer, Samuel de Champlain, who, in the lake that is so well known to every school-boy, has transmitted his name to posterity.

It is certainly worthy of notice that, as a rule, neither the French nor the Spanish explorers made any attempt to stamp their own names upon the map of North America. True, the French did not forget their king, Louis XIV., as appears in Louisiana, and Champlain is honored, as he should be, thru the lake bearing his name; but Marquette, Hennepin, La Salle, De Soto, and Joliet would not enjoy even the slight prominence which they now possess had it not been for generous and admiring Englishmen who named counties and cities after them.

We English, however, are not averse to that geographical immortality that is secured thru a name on the map. In proof of this mild statement it may not be amiss to give a few illustrations. We think you have all heard of Brownsville, Jonesburg, Smithfield, Russellville, Hayesville, Pughtown, Gilbertsville, Boyertown, Norristown, Harrisburg, and last, but not least, Pottstown. In the light of this comparison, which we think is a fair one, do not the French and the Spanish appear remarkably modest?

If want of modesty were the only charge that could be brought against us in this matter, we might be well content; but some of our pioneer explorers have been seriously deficient in the refinements of polite society, and this deficiency has shown itself in the geographical nomenclature of the West. However, as our friend Dr. Redway remarks, "The severest critic cannot complain that they are lacking in vigor of expression. As witnesses there are 'Boot-jack Ranch,' 'Dirty Devil River,' 'Dead Mule Gulch,' 'Devil's Kitchen,' 'Shoo Fly,' 'Shanty-town,' 'Slab-town,' 'Hang-town,' 'You Bet,' 'Whiskey Flat,' 'Poker Flat,' 'Hell's Delight,' and 'Hell Roaring Forks,' all of which are names that are, or have been, in legitimate use."

There is one very remarkable fact to be observed in the names of rivers—they possess wonderful vitality. The rivers of the world were named by the earliest races, and these names have been retained for thousands and thousands of years. In our own country nearly all of our important rivers retain their Indian names. The St. Lawrence and the Hudson are, of course, conspicuous exceptions. The names of mountains are also remarkable for their antiquity and immutability; and, indeed, in this particular they rank next to rivers.

A study of the names upon the map of the United States would, even in the absence of all historic records, reveal the fact that this country was originally colonized by three nations from Europe—the English, the French, and the Spanish. The student of names might also discover traces of the Dutch in the vicinity of New York.

Beginning at the Gulf of St. Lawrence, there is a wide stream of French names extending along the river of the same name, around the Great Lakes and down the Mississippi to the Gulf of Mexico. This stream of names indicates the presence, at one time, of the French in this part of the continent. Along the Atlantic slope from Maine to southern Georgia lies a great blanket of English names. This proves that the English settled here. In the extreme South and West, we find clusters of Spanish names and these bear testimony to an occupation by the Spaniards.

It will be seen at once that the conclusions reached thru a study of the names upon the map, are in perfect harmony with those which we have drawn from the study of history. Since our country is young, since her towns, counties, and states have been named within historic times, we may reach our conclusions respecting the movements and the distribution of the different races of men thru either of two channels. We may study these matters by the aid of geographical nomenclature or by the aid of the light that comes from history. But in an old country (using the adjective in the historic and not in the geological sense), like England or France, there is often but one source of information left, for many of the names found there were given in prehistoric times.

Let us now enter the Gulf of St. Lawrence from the Atlantic and study the meaning and observe the significance of the names encountered as we advance towards the Gulf of Mexico by way of the St. Lawrence, the Great Lakes, and the Mississippi. If we enter the Gulf by the northern route we must pass thru the Strait

of Belle Isle. This, of course, smacks of French, for as in this language *bon* means good and *beau*, handsome, so *belle* means beautiful; and Belle Isle is, therefore, the French for beautiful isle. Had we entered the Gulf by the southern route we should have been obliged to pass thru Cabot strait, a name which at once brings to mind the brave and adventurous Englishman upon whose discoveries the Kings of England based their claims to the North American continent. But we must not now turn aside to consider English names. The fact, however, that there are but two routes by which the Gulf of St. Lawrence can be reached from the Atlantic, and the additional fact that the French named the one line of approach while the English named the other, are most significant when we remember the subsequent bloody struggle that occurred between these two powers for supremacy in the New World. Only a few miles south of the Beautiful Isle is Notre Dame bay,—Our Lady's bay named after the noble Gothic cathedral of that name in the city of Paris. The Gulf of St. Lawrence and the river of the same name were, of course, named in honor of that saint.

Passing up the St. Lawrence we come, just below Quebec, to the island of Orleans. Orleans is the name of a city in northwestern France, and this name was brought by the French from the Old World to the New. Joan of Arc, or the Maid of Orleans, who lived and died before Columbus discovered America, throws a halo of historic interest around this name. Additional interest centers in the word when we remember that it is derived from the Roman Emperor, Aurelian, who, when celebrating the most magnificent triumph that had been witnessed since the days of Pompey and Cæsar, compelled the beautiful Zenobia, Queen of Palmyra and the East, confined by golden chains, to walk before his chariot thru the streets of Rome.

Quebec, too, is a name transferred from France, and Montreal (Royal Mount) proves not only the presence of the French, but also indicates a physical feature of the vicinity.

La Prairie, a town near Montreal is French for the meadow. Montpelier is the mountain of young girls, while Vermont—*verd*, green, and *mont*, mountain—is green mountain.

Even the Pine Tree State, good old Maine of New England, repeats in the New World the name of one of the maritime provinces of France; and Richelieu, the outlet of Lake Champlain keeps green the memory of the great French statesman.

Passing farther west we feel certain that we have not lost the trail of the French when we come to their word for a strait,—Detroit. Sault de St. Marie is the "fall of St. Mary;" Fond du Lac is the "head of the lake"; and Lake Superior is the "upper lake".

Passing to the Mississippi we are much impressed by the word Prairie du Chien. *Prairie* is the French for meadow, *chien* for dog, and *du* is simply a sign of the genitive case. Prairie du Chien is, therefore, the "meadow of the dog", and the presence of this name along the Mississippi shows that the little prairie dog was well known there in those early days.

Des Moines means the "city of the monks," and indicates one of the many mission stations established by the French for the conversion of the Indians.

Every school-boy will be glad to learn that Baton Rouge is the French for red stick, but it will add much to the interest if it is explained that the word was suggested by the bright red bark of the tall slim cedars that grew in the vicinity.

Soon after entering the valley of the St. Lawrence, we encountered the name Orleans, and now we have almost reached the Gulf of Mexico, have reached the other end of the long, broad band of French names, and again meet the same name with the adjective new used as a prefix. This, indeed, is a favorite trick in geographical nomenclature, and we suggest that a study of this phase of historical geography may be made very interesting and instructive to the pupils in our classes.

For one minute I wish to return to the Great Lakes. But one of the five, Superior, would suggest that the French at one time occupied this portion of our continent. The names of the other four are of Indian origin, a good illustration of the rule that the names of bodies of water possess great antiquity and vitality.

Let us now turn to the great blanket of English names found upon the Atlantic slope from New England to Florida. "A religious feeling," says Isaac Taylor. "equally intense with that which dictated the names bestowed by the Spanish discoverers, but very different in character, is evinced by the names which mark the sites of the earlier Puritan colonies in North America. Salem was intended to be the earthly realization of the New Jerusalem, where a new Reformation of the sternest Calvinistic type was to inaugurate a fresh era in the history of the world, and a strict discipline

was to eradicate every frailty of our human nature from this city of the saints."

Some idea of the means employed to attain this ideal condition may be gathered from a few samples of the "Blue Laws":

"No one shall run on the Sabbath or walk in his garden."

"No one shall make beds, cut hair, or shave, and no woman shall kiss her children on the Sabbath."

"No food or lodging shall be given to any Quaker or other heretic."

Roger Williams, strange to say, had been chosen minister in Salem; but while this name means peace, Roger did not find the name in harmony with the prevailing conditions. Our students of geography should, we think, be made familiar with the story of his flight, and should be told why, in simple piety, he called his new resting place Providence,—a town which still remains the capital of Rhode Island.

Concord, the capital of New Hampshire, speaks of the quiet and harmony which the weary pilgrims longed to find, while Philadelphia, the City of Brotherly Love, tells a touching tale of the unbrotherly persecutions which filled the prisons of England with 60,000 Quakers.

In the dreary month of December, in 1620, a band of brave exiles landed on a desolate spot, five hundred miles from the nearest settlement of white men. "To this spot," says Taylor, "they gave the name of Plymouth, a reminiscence of the last English land which they had seen as they passed down the Channel."

Boston, Worcester, Cambridge, Hartford, Reading, Newport, Newark, Chester, Sheffield, Biddeford, Greenwich, Lancaster, and many other names were carried over from the Old World and give a striking proof of the fact that wanderers and sojourners in a strange land find comfort in the names which have been familiar since childhood.

If the emigrants feel less and think more, if they are more controlled by the head than by the heart and wish to discriminate between the names on this side of the sea and those on the other, they simply prefix the adjective new and the work is done. As illustrations of this trick in geographical nomenclature we have New England, New York, New Jersey, New Hampshire and scores of others of less note.

At this point we wish to direct attention to one striking fact.

In the names found north of Mason and Dixon's line very few references to royalty or to the aristocratic forms of England are to be found. Did we not know from our study of history that the Puritans and the Quakers settled the greater part of this portion of the New World, an examination of the names upon the map would lead us to this conclusion.

Examining the names of the Atlantic slope south of Pennsylvania we find that Maryland was named after Henrietta Maria, the Queen of Charles I.; Delaware calls to mind the first governor of Virginia, Lord De la Ware; Virginia reminds us of Elizabeth the "Virgin Queen;" North Carolina and South Carolina are easily traced to the worthless Charles II.; and Georgia, the youngest of the original thirteen states is named from George II. of England.

Baltimore is the name of a village in Ireland from which Lord Baltimore derived his title. The city of Charleston, Albemarle sound and the rivers Ashley and Cooper refer plainly in their names to men who were conspicuous at the time of the Restoration.

Annapolis (a compound of Ann and *polis*, the Greek for city,) is named from Queen Anne, and the river Rapidan (Rapid Ann) comes from the same source. Fredericksburg, the scene of a bloody battle in the Civil War, and Frederick City, Md., bear the name of the son of George II.

As we enter Chesapeake bay we find Cape Charles on the one hand and Cape Henry on the other. Cape Charles was called after "Baby Charles," who, in manhood, was brought to the block; and Cape Henry bears the name of the hopeful prince whose accession to the throne would probably have changed the whole course of English history. This was the prince who was so warmly attached to Sir Walter Raleigh, and whose death occurred under suspicious circumstances.

Elizabeth county, the scene of McClellan's campaign, was so called in honor of the sister of these princes, while the James river received its name from their father, James I.

The names upon this part of the map leave us in no doubt concerning the country from which the settlers came, nor do we grope in uncertainty respecting their relations with royalty. Here, we say with confidence, must have been the home of the cavaliers.

The intelligent and faithful teacher of geography will find, in the facts just enumerated, and in many others of like character, excellent material with which to arouse an interest in English his-

tory. Not only will geography have a deeper meaning and a greatly increased interest to the pupil, but the sunny and fruitful fields of history will be brought temptingly into view.

Young people are always strongly attracted by biography, especially when it is that of brave and daring navigators. In the ice-bound seas of the far north we find a record of the achievements of many famous Englishmen.

It was Martin Frobisher who declared that the discovery of the North-West passage was "the only thing of the world that was yet left undone by which a notable mind might be made famous and fortunate." Undaunted by a thousand difficulties he pushed on and discovered the water that bears his name. Martin Frobisher fought against the renowned Spanish Armada and was knighted for his services in this action. He died fighting for Henry the IV. of France against the Spaniards.

John Davis followed Frobisher and discovered the open passage leading to the north-west to which the name of Davis' strait has very properly been assigned.

Then came William Baffin who surpassed all that Davis had done, and who boldly ventured into seas, where, for two hundred years, none dared to follow him. He discovered the great expanse of water that is known by the name of Baffin's bay, and here he coasted around in hope of finding some outlet towards the north or west. Three channels were discovered, to which he gave the names of Sir James Lancaster, Sir Thomas Smith, and Alderman Jones thru whose pecuniary assistance the expedition had been made possible.

Some knowledge of the adventurous life and tragic fate of Henry Hudson will make Hudson river and Hudson strait and Hudson bay mean more to the members of the geography class. Hudson's first attempts to reach the far East were made by the way of Spitzbergen and Nova Zembla. The company employing him promised that, if he should lose his life in the attempt, it would pay his widow the very generous sum of $80. Failing to reach China by sailing to the north-east, he determined to try to find a north-west passage and finally reached the great inland sea which has ever since been known by his name. His ship was frozen up among the ice floes of the southern extremity of Hudson's bay, and while waiting for spring the crew was reduced to feeding upon moss and frogs. After much trouble they succeeded in catching

enough fish to furnish provisions for fourteen days. "Dismayed at the prospect of starvation," says Isaac Taylor, "the crew mutinied, and with the object of diminishing the mouths to be fed, they treacherously seized their brave captain; and having placed in a small boat a little meal, a musket, and an iron pot, they cast Hudson adrift with eight sick men to find a grave in the vast sea, the name of which is the worthy epitaph of one of the most daring of England's seamen." His fate was revealed by one of the mutineers and an expedition was sent from England in quest of him, but no trace of him has ever been discovered.

Cape Parry, Parry's sound, and Parry islands are places that will be full of interest to pupils who know something about the brave and daring Englishman after whom they are named.

Sir William Edward Parry started with Captain John Ross to pass thru Lancaster sound. After sailing about sixty miles, Ross thought he saw the way closed by a range of mountains and he therefore turned back. The English people agreed with Parry in thinking the mountains an optical illusion, and the next spring Parry, having been supplied with everything necessary for such a voyage, returned and passed thru the channel without seeing the mountains. He explored and named Barrow strait, Prince Regent inlet, and Wellington channel and entered the water that has since been called Parry or Melville sound.

Parry was the first man to reach longitude 110° west and therefore received the reward of £5000 offered by the English parliament to the navigator who should first reach that meridian. While wintering at Melville island in 1820, he entertained his crew and kept up their spirits—a most important matter—by means of theatrical performances, the publication of a newspaper, and like devices.

In 1827 Parry did his most famous work. In that year with Lieutenant James C. Ross, he started from Spitzbergen for the North Pole. He was provided with boats that could be fitted with runners. As long as they could find ice, they would use their sledges, but if they came to water they would take to their boats. These daring, plucky men got as far north as 82° 45′—a northing that was not surpassed until 1882—fifty-five years later—when Greely reached 83° 24′ north. In 1895, Nansen passed far beyond all other arctic navigators reaching 86° 13.6′; and in 1900, the expedition led by the Duke of Abruzzi advanced twenty-one miles further than Nansen.

We cannot take space even to name all the Englishmen who have done so much to increase our knowledge of the arctic regions, but we must take time to at least write the name of him who was bravest among the brave--Sir John Franklin. Franklin bay, Franklin channel, and Lady Franklin sound keep green the memory of husband and wife. What a mass of intensely interesting history lies beneath these names! Here the teacher will have an enviable opportunity to correlate history and geography in a most fascinating manner.

Of course no teacher will forget the brave Americans whose names are stamped upon the map of the arctic regions. Kane, Greely, Grinnell, Hayes, and Peary, the world delights to honor; and our boys and girls should not be ignorant of their noble, inspiring work.

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THE EARTH'S INTERIOR

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From the earliest ages to the present day the earth's interior has been a source of mystery. Primitive man peopled the earth's subterranean regions, its caves, its volcanic vents and the bowels of every mountain with supernatural and superhuman beings—gods and goddesses -who controlled the destiny of men's lives or added much to the weal and woe of human life. The dispelling of such superstitions by modern science has not, however, solved the mystery of the earth's interior. It is as puzzling as ever and I propose to discuss this question not because I have anything of value to contribute but because it may be well for us to have the state of our present knowledge somewhat fully presented.

Surface Temperature of the Earth.--The temperature of the earth's surface near the equator is about 80° Fahrenheit but the change of the sun's position north or south of the equator causes its heat giving power at the equator to change slightly and thus is caused a seasonal variation of temperature. The alternation of day and night, the variation in the quantity of rainfall and of the quantity of moisture in the atmosphere and other causes also effect variations in the temperature of the earth's surface in this latitude.

The temperature, however, near the equator does not vary more than ten or fifteen degrees, while in the temperate zone where the obliqueness of the sun's rays and the relative length of day and night change more than in the torrid zone, the temperature of summer may be greater than at the equator and the temperature of winter fall below the temperature of freezing water, in this way the seasonal variation in the temperate zone may equal fifty or sixty degrees while the day and night variation may be in somewhat exceptional cases just as great.

In the frigid zones the variation may be as great as 185° as at Verkhoyansk in Siberia where the winter temperature has been —89° and the summer temperature +96°.

Stratum of Invariable Temperature.—Three or four feet below the earth's surface, the temperature varies much less than at the surface and the deeper we go the less the variation becomes until finally a stratum of no variation is reached.

The small amount of variation of temperature a short distance below the earth's surface is a matter of common observation in cellars and wells. For even if the winter temperature of the surface of the earth falls to twenty degrees below zero and the summer temperature rises to one hundred degrees yet freezing temperatures in winter and a higher temperature than seventy degrees may rarely occur in cellars and never occur in wells, and in our lattitude wells more than sixty feet in depth have little or no variation summer and winter.

Depth of the Stratum.—Owing to the small range of temperature on the surface at or near the equator, the stratum of no variation lies from two to six feet below the surface and has a constant value of about seventy degrees Fahrenheit. In the temperate zone this stratum lies from forty to two hundred feet below the surface and has a temperature of about fifty or sixty degrees depending upon latitude and conductivity for heat of the rocks near the surface as well as the humidity of the air. In the frigid zone the depth may be as much as three hundred to five hundred feet and the temperature value about the freezing point of water.

If, however, in the frigid zone the ground is always frozen below the surface, the stratum of invariable temperature may be closer to the surface than it is in the temperate zone. This rise toward the surface is caused by the poor absorbing and radiating power of ice and its property of absorbing heat from the adjacent

strata when melting and imparting heat when freezing and thus both preserving and causing more equable temperature conditions below the surface.

Increase of Temperature.—Observations made in mines, artesian wells and caverns show that within the stratum of invariable temperature the earth heat gradually increases. In some localities the rate of increase is as rapid as one degree in twenty feet while in others it is as slow as one degree for every two hundred feet. The average rate of increase as far as the average of all known observations will show this, is about one degree for every fifty-three feet or nearly one hundred degrees to a mile.

The different rates of increase are due (1) to the different specific heats of different rocks, (2) to the continuity or lack of continuity of the rock strata, (3) to the capacity of different rocks for conducting heat, and (4) to the amount of ground water in the rock pores. Thus, if the rocks of a locality are good conductors of heat the rate of increase will be slow, but if poor conductors the rate will be rapid.

The deepest artesian well so far bored is in the Caspian sea region where a depth of over nine thousand feet was attained and a temperature of some 190 degrees reached. This depth, however, is very superficial when compared with the radius of the earth for it is only about 1-2350th of the distance to the earth's center. Now the rate of increase in the Caspian well agreed with the average rate of one hundred degrees to a mile yet it is not at all probable that the same rate would continue constant to the very center of the earth, for with the observed rate of one hundred degrees to a mile a temperature of three thousand degrees would be attained at a depth of about thirty miles below the earth's surface and this is a degree of heat great enough to melt almost every known substance found on the earth's surface; and further if this rate is continuously persistent to the earth's center a temperature of no less than four hundred thousand degrees would be attained. This is a degree of heat entirely inconceivable to us and such a temperature would no doubt exert so enormous an expansive force that it would reduce all known substances into gases of extreme tenuity.

The effective heat of the sun has been variously estimated at ten thousand to fifty thousand degrees centigrade. But if the Nebular hypothesis be accepted the interior earth heat must be less than

that of the sun instead of being at least twenty times as great. And even assuming an increase of two and five-tenths degrees per mile instead of one hundred degrees the temperature of the earth's center would be ten thousand degrees or equal to the effective heat of the sun. Even this is hardly possible because the ten thousand degrees or more keep the sun in a gaseous or nearly gaseous condition while the earth is at least solid at its surface. Especially is this true since the attraction of gravity on the sun is twenty-seven times as great as on the earth and consequently a higher degree of heat would be requisite for liquefaction on the sun than on the earth.

In view of these facts we are forced to conclude that the temperature increase of one degree for every fifty or sixty feet is true only for a superficial crust of the earth, while within the rate becomes slower and slower until a central mass of greater or less extent is uniformly hot.

Isogeotherms.—Within the stratum of invariable temperature points having the same degree of heat may be connected by lines or more properly by surfaces each of which is called an isogeotherm. The word means etymologically *equal earth heat.*

If rocks possessed equal conductivity the different isogeotherms would form a series of regulary concentric surfaces with regularly increasing temperature to the outer surface of the uniformly heated central mass.

The stratum of invariable temperature is not an isogeotherm because it is a surface connecting points within the earth whose temperatures never vary.

Water Within the Earth.—About one third of the water precipitated on the earth in the form of rain, snow, dew, etc., runs off and forms rivers and lakes whose waters are either taken up by evaporation or finally reach the sea. Another third is evaporated while the remainder soaks into the ground and permeates the rocks of the earth's crust. This water may be called *ground water.*

The impression prevails sometimes that rocks are either permeable or impermeable, but experiment will show that all rocks below the earth's surface as far as man has penetrated are permeated with water. This is due to the fact that all rocks are more or less porous, and with the force of gravity ever acting upon it, the ground water must slowly gravitate toward the earth's center. But with increasing depth the quantity of overlying water increases

and forces the deeper waters with greater velocity downward toward the earth's center. For this reason deep mines always present serious problems of drainage and heavy expense must be incurred in keeping them free from the percolating waters. One of the reasons for the practical abandonment of the rich Comstock lode was the immense difficulty and cost entailed in pumping out the water that seems to pour in on every side.

Depth Attained by Ground Water.—If the earth's interior were cold, the force of gravity would impel the ground water to the very center of the earth. The high temperature attained, however, a few miles below the earth's surface, must cause the vaporization of the water, thus driving it outward again and preventing further percolation downward. But, owing to the immense pressure of the overlying rock and water, the vaporization point must be far above 212°, the boiling point of water when the normal pressure of one atmosphere, or 14.7 pounds per square inch, is exerted. For suppose the depth to be three miles, then the pressure of rocks downward would not be less than one thousand atmospheres, while the temperature would not be greater at that depth than about 355°. At a depth of thirty miles the pressure would be ten thousand atmospheres and the temperature about three thousand degrees, at which temperature the expansive force of the heat is enormous and may balance or even greatly exceed the pressure. Under high temperatures such as these, and when expansion and pressure are nearly in equilibrium, the tendency of water to pass explosively into steam is well known, and may be a cause or even the cause of explosive eruptions of volcanoes.

Melting Point of Rocks.—Many substances fuse at comparatively low temperatures; others are fusible with difficulty; while others still seem entirely infusible at known temperatures. The common rocks of the earth's crust are all fusible at the temperatures that are inferred to exist within the earth, probably at less than three thousand degrees. But tho this be true, experiment has shown beyond doubt that pressure raises the fusing point of rocks as well as the vaporization point of water, and consequently the melting point of subterranean rocks is higher than that of the same rocks at the surface.

Influence of Ground Water.—It is a well known fact that very hot water or steam forced into a board or plank renders it so soft that it may be moulded or bent into any shape. Experiments with

intensely hot rock permeated with water renders it probable that they too become more plastic and assume the plastic condition far below their melting points. In consequence of this, rocks a few miles below the surface may be in such a condition of plasticity that no rock cavity nor fissures can possibly exist and any relief of pressure at one place may cause a slow migration of plastic rock materials from another place to produce equilibrium of pressure.

Density of the Earth's Interior.—All the rocks entering into the composition of the earth's crust have been weighed and their specific gravities determined. An average of all their densities is about 2.5; each cubic foot of the earth at the surface weighs about 2.5 times 62.5 pounds, or 156.25 pounds. But the density of the earth as determined by Cavendish is about 5.6 times that of water, and consequently the density increases from 2.5 at the surface to about eleven at the center. The increase of density is partly or perhaps wholly due to pressure, which at the depth of a few miles is said to equal the crushing strength of steel. For illustration, let us suppose the density not to increase as we proceed below the surface. Then each cubic foot of the earth will exert a pressure, on an average, of about 160 pounds on the cubic foot below it and therefore on a square foot of surface. Hence, at a depth of a mile, the pressure would be 5,280 times 160 pounds, or 844,800 pounds per square foot, or 422 tons, and at ten miles, 4,220 tons. But, since the increase of pressure produces greater density, each cubic foot would weigh a little more than the one above it and consequently the pressure at ten miles might greatly exceed 4,220 tons. But there is still another element to be considered, for this estimate is made on the assumption of no increase of heat in approaching the earth's center. But the heat as well as the pressure increases, and for a certain distance down into the earth's crust the expansion effect may balance or even overbalance the effect of pressure. This probably leads us to the conclusion that the earth's nucleus may have a density even greater than eleven, and probably as high as sixteen.

Constitution of the Earth's Nucleus. —In order to get a clear conception of the earth's interior—of what we know or do not know—it is also necessary to consider another phase of it, which is the constitution of the internal mass. The density of the central nucleus is so great that it is either composed of the heavier metals or the enormous pressure has overcome the expansive force of the

high degree of heat. The first supposition will be considered later, but the latter is often considered the more probable because with increasing pressure the mass within must become so homogeneous and continuous that its conductivity of heat is greatly increased and so heat becomes more uniform, and thus pressure toward the center increases faster than expansion outward.

State of Aggregation of the Earth's Interior.—From what has been said so far, it is evident that there are several possible suppositions as to the state of aggregation of the earth's interior. (1) The earth is fluid within covered by a solid crust. (2) The earth is solid to the center. (3) The earth has a liquid layer enclosed between a solid nucleus and the solid crust. (4) The earth has local fluid portions within.

Reasons for Believing the Earth Fluid.—Prior to the middle of the eighteenth century most scientists believed the earth to have been primitively fluid thruout. The cooling of the surface of this primitive molten globe produced a crust over the earth's entire surface which thru the radiation of internal heat was ever becoming thicker and consequently more rigid.

The evidence in favor of this view consists chiefly of (1) the known increase of temperature within the earth, and (2) the fluid condition of many of the products of volcanic eruptions.

The objections against the earth's interior fluid condition are, however, much more weighty. First, if the earth is fluid all volcanoes are the vent of the same fiery interior and consequently volcanoes situated close together in any region should show some connection in their volcanic eruptions and association in their volcanic phenomena. Instead of exhibiting this, their manner of action, continuity of action, and materials ejected are all characteristic of the individual volcano. Thus Mauna Loa about fourteen thousand feet high and Kilauea ten thousand feet lower down on the *same cone*, are calderas which have no connection with each other in time of eruption tho manner of action and materials ejected are similar. Then again Stromboli, "the lighthouse of the Mediterranean," is ever active, ejecting steam, volcanic dust and molten lava, while Etna and Vesuvius not far away have periods of activity and quiescence.

Second, that the earth was primitively fluid is not an evidence that it is still fluid within. For the radiation of heat from the molten interior would take place most rapidly from the surface and

when the cooling had proceeded far enough to congeal a crust upon the earth this crust would necessarily, from known laws of cooling, be heavier than the molten liquid beneath. The tidal surging of the fiery liquid within would then break the crust into blocks each of which would sink into the primitive liquid and thus a solid nucleus would be built up.

Third, a crust inclosing a liquid interior would be subject to deformation by the tide producing attraction of the moon and sun. This would lower the actual tide of the ocean since any elevation of the crust during the passage of the sun or moon over any point of it would correspondingly reduce the height of the water in the tide. Lord Kelvin has estimated that even if the earth were as rigid as steel the tides would only be two-thirds as high as on a perfectly rigid globe.

Fourth, with a liquid interior tides would be produced within as well as outside the crust, and this interior tide like the tides of the ocean would move from east to west around the earth and thus act as a brake against the west to east rotation of the earth. The slow retardation of the earth's axial motion would result in slowly lengthening the day. No such effect has been noted by astronomers.

The objections to the theory of the fluid condition of the earth's interior are all points in favor of the view of the earth's solidity.

The great density of the earth's interior is a strong reason for believing the earth's center solid but there is another stronger reason. This is drawn from the science of earthwave or seismology. It has been found that earthquake waves originating in Japan or other eastern countries have been transmitted to antipodal points in such a way and in so short a time that they must have traversed the interior of the earth. Now waves are of two kinds, viz., waves of compression and waves of distortion. The former travel with the greater velocity and are felt first producing a series of minute tremors and are followed after a distinct time interval by more strongly marked movements of the earth. The latter are believed to be waves of distortion. Now waves of compression may be transmitted from a solid to a liquid and back again to a solid without considerable loss, but waves of distortion are not transmissible thru liquids or gases. Consequently if the more marked disturbances following the tremors are

really waves of distortion the earth must be solid thruout. The only objections to this reasoning lies in our slight uncertainty about the direction of transmission, for the waves may really travel around the crust instead of thru the earth. Knowing, however, the discontinuous character of the rocks of the earth's crust and the velocity with which the various rocks transmit vibrations, it is hardly possible that the waves felt traverse the circumference instead of the diameter of the earth.

Reasons for Believing the Earth to Have a Liquid Layer Inclosed Between a Solid Nucleus and the Solid Crust.—The difficulty of explaining the ejection of molten lava from volcanoes without assuming a liquid interior and furthermore of reconciling a liquid condition with the known effects of pressure upon liquids and gases has led some scientific men (tho very few) to assume a liquid layer between a solid nucleus and the solid crust. This as already shown only augments the difficulty of explaining volcanic action. It may be a possibility, however, that owing to the comparatively rapid increase of heat for the first part of the descent toward the earth's interior and the slower rate further down, the expansion effect may increase more rapidly than the pressure and that therefore the crust may gradually shade from the solid state into the viscous condition and finally to the liquid. At what depth this might occur we have no data at hand to determine, but beyond a certain depth the pressure must certainly increase faster than expansion due to the heat; in which case the conditions would be reversed.

Local Reservoirs.—Each volcano is independent of others in its eruptions and yet ejects molten lava. In order to explain both of these phenomena, the theory of local reservoirs of molten material within the crust was devised. After what has been said about the other theories it merits no more than a reference. It may be said, however, that since fully one-half of the hot materials ejected from volcanoes is steam and that nine-tenths of all volcanic eruptions are explosive, the assumption of either a continuous liquid interior or of local reservoirs is unnecessary in the explanation of volcanic phenomena, because with an intensely heated interior any relief of pressure would produce the local reservoir.

The Interior of the Earth as a Source of Heat.—The quantity of heat which reaches the surface of the earth at the present time must be comparatively small. Yet Lord Kelvin estimates that the quantity conducted annually to the surface is sufficient to melt a

layer of ice .0085 of a millimeter in thickness over our entire globe. This is a mass of ice 777 cubic miles in volume, and would be equivalent to $777 \times 5280^3 \times 56 \times 142$ heat units, Fahrenheit.

If we assume the original fluidity of the earth, when the crust was much thinner than at the present, the quantity of heat received at the surface must have been great enough to melt any ice-cap tending to form in the polar zones and this explains the torrid character of the fossil faunas and floras of high latitudes.

Origin of the Interior Heat of the Earth.—If we accept the Nebular theory, the condensation of the gaseous mass which was originally aggregated to form the earth may have originated the internal heat of the earth; for gravity acting on the gaseous, perhaps formless mass, caused aggregation into a globe, and in doing this caused increased molecular vibration, producing heat just as hammering a piece of iron makes it hot by increasing molecular vibration.

Many authorities however claim that the interior heat of the earth is due to the oxidation of various rocks within the earth, such as pyrite and marcasite; for such oxidation is known to be the source of heat in some mines and mineral springs. The crushing of rocks is also a source of heat within the earth, but whether this would account for the whole supply or not is undecided. Mallet after long study of volcanic phenomena came to the conclusion that heat enough would be developed in this way to form all the volcanic islands of the globe. He also concluded that since the upheaval of these mountains has been going on thru a long period of time, a small annual crushing would account for those made in any particular epoch of the earth's history.

A STUDY OF THE RIVER

BY RUTH E. DOWLING, STATE NORMAL SCHOOL, MOORHEAD, MINN.

In turning over the pages of text-books used in the common schools twelve or fifteen years ago and others in general use before that time, one can find the sentence, so familiar to many ears, which declares that "A river is a stream of water running thru the land." It would take but little observation on an actual river to show that there is in this definition no mention of the most important point in the consideration of a river, viz., its work in cutting and carving the land and in transporting its waste on and on till it reaches the sea. Then, too, nothing is said in this definition of the direction of the river's flow. It might flow up hill or down, over hard or soft rock with equal readiness.

During the last few years the inadequacy of this old definition has been more or less generally recognized, and efforts have been made to improve upon it by bringing in the river's work as a transporting agent and the destination ahead of all rivers. This effort has resulted in the alliterative statement that, "Water and waste on its way to the sea is a river." If this brought in an adequate conception of the river as a worker in carving channels, and if it did not omit all idea of the life cycle of a stream subject to possible interruptions, it might be left, and this paper would not be written.

What, then, is a river? What its life work? How does it do that work? How does it pass thru a life cycle?

Origin of the River.—The best place to begin on anything is at the beginning, and that leads to inquiry in regard to the origin of rivers. All water that falls upon the earth as rain, snow, dew, frost, etc., is disposed of in one of three different ways. It may be taken back into the air by evaporation; it may flow down the slope of a surface as a wet weather stream and disappear as dry weather ensues; or, it may soak into the ground permeating it thru and thru in the form of ground water, emerging as a spring which may

flow down a slope as a small river, increasing in volume from side drainage until a distinct river system is formed. Sometimes a lake is spoken of as the source of the stream that forms its outlet, but would not the source of water supply for the lake be more accurately named the source of the river? And is the one larger stream, which is generally called the inlet to the lake, the only source of supply? Surely the other smaller streams that flow into the lake or into the so-called inlet help just as truly to feed the lake as does the one larger one, even tho the work of the larger stream may be greater. And where do these smaller streams get their supply but from the accumulation of ground waters in the form of springs and from occasional additions from the general sheet of moisture in times of wet weather?

If these arguments hold true in actual nature, and careful observation will be pretty sure to prove them, then it will be seen that there is no such thing as *the* source of *a* stream, but that all streams gather their supply of water from a poorly defined area about their headwaters, and this is increased as the river advances toward sea level by the additions from tributary streams, which have in their turn gained their supply in the same way. One other thing that makes the location of the source of a stream still more indefinite is the fact that as the water takes its way toward lower levels, it is bound to tear away the soil even to the point of removing the elevation which may have served as a divide between two drainage systems. In this way another divide is established farther away from its former headwaters, and arrangements are made for the drainage from this new slope to join the headwaters, thus shifting its source. With this idea, one's conception of a river is enlarged to include not only the trunk stream but all tributaries and side streams, each with possibilities of change of position and enlargement.

Relation between River, Valley, and Load.—The river well started, the next question that confronts us, is how it does its work, and in the study of this problem one is brought face to face with one of the most delicately adjusted bits of mechanism to be found in all nature.

The two elements in the work to be done are the cutting of the channel down to sea level, and the carrying of its waste to the sea. The two agencies which the stream can employ to do this work are its volume on the one hand, and on the other, its velocity.

Careful study of these four elements in the upper and lower courses of any river show that in the upper course where the volume is small, and friction on the sides is sufficient to wear away a relatively heavy load of coarse waste, the stream adjusts itself by increasing the steepness of its slope, thus adding to its velocity.

In the lower course, where its volume is increased by the contributions of many side streams, the river is able to carry its heavy load rapidly even on a fainter slope. The fineness of the waste due to long wearing also helps this. "The lower Mississippi has a descent of two or three inches per mile, yet it bears 6,700 million cubic feet of suspended silt, 750 million cubic feet of silt dragged along the bottom, and 1,400 million cubic feet of mineral substance in solution, every year." Prof. W. M. Davis' Physical Geography, page 239.

Whenever there is a decrease in the load of waste, the stream then having less to carry, proceeds to grade its slope by laying down waste on the one hand, and by cutting down projecting ledges on the other. The Niagara river wearing back at the rate of two or three feet per year the ledge over which the famous falls dash their millions of tons daily is a clearly defined example of degrading of channel, while the pile of waste below the falls and particularly near the inlet to Lake Ontario shows the process of aggrading, both of which are tending to bring the Niagara river and the entire drainage system to grade. This process of grading is going on in all the rivers of the world, various stages being exhibited in different rivers, but more, perhaps, of the larger ones showing the mature or nearly graded condition, where the valley floors extend with a relatively even slope nearly to the headwaters of both trunk and tributary streams and exhibit almost perfect adjustment between work to be done and power to do it. Truly nothing but the stream itself could have so delicately adjusted its tools and workshop. This delicacy of mechanism and its evident proof of the source of power are even more clearly shown in the way in which side and trunk streams join at accordant levels, instead of leaping over canyon walls.

Territorial Disputes Between Drainage Basins.—One other feature in the life-work of rivers which, perhaps, more than anything thus far considered shows their life-like behavior, is the shifting of divides, the territorial disputes between neighboring streams or systems.

In a young land form, a coastal plain for example, the drainage pattern is, roughly speaking, a series of parallel streams flowing from the old land to the sea following the slope of the coastal plain. As the streams wear deeper and deeper into the plain, the slope of their valley walls becomes more and more gradual, thus offering greater opportunity for side streams to enter the trunk streams already established. The side streams will advance headward as waste around their headwaters gradually slips into their channels, and the highland between becomes the debatable ground, the theatre for border warfare.

The stream which has the greatest volume will, of course, be the most powerful in cutting down its channel, and so in gaining drainage area, working so vigorously that it may capture the tributary of its neighbor stream, and after a time divert even the headwaters of the second trunk stream into its own channel. This is clearly what has happened in the case of the headwaters of the Chattahoochee in Georgia, where the headward movement of the Tugaloo, a tributary of the neighboring stream, the Savannah, has beheaded the Chattahoochee. The divide between the streams flowing into the Atlantic and those flowing into the Gulf of Mexico has clearly been pushed far to the westward, so that there is but little ground between the two drainage systems in the lower course of the Chattahooche, while in the north the Tugaloo has actually turned its headwaters now called the Chateuga river into the Atlantic drainage system thru the Savannah.

Thus far it has been assumed that the life work of a stream would go on without interruptions, that the river would pass thru all stages of its development peacefully and without difficulty. It is well for the sake of clearer understanding to take this view first; but a discussion of the subject of rivers would be very far from complete, if it did not take into account the possible interruptions to which the work of streams is subject.

Elevations and depressions of the land surface are known to be common occurrences, the depressions being clearly discernible in the numerous drowned valleys in the northern half of the Atlantic seaboard in the United States as well as in Greece and in Norway. In these depressions the work of the rivers which enter these long bays has been hastened towards completion by a decrease in the amount of work to be done. On the other hand, the land surface is often elevated by some internal force; and the rivers

working within the uplifted area find that instead of being near to sea level with their life cycle nearing its completion as before, they are now above their former level and have still more work to do. Quick to feel these new responsibilities, they immediately begin to deepen their channels, entrenching themselves in their former flood plains, and working with renewed energy as befits them in their rejuvenated condition. The Rhine is a striking example of this. The broad upland surmounted here and there by monadnocks of more resistant material is first cut by a broad terrace. In this broad terrace is cut a steep gorge in which the river now lies. The youthful appearance of the gorge would argue a recent formation, while the broad terrace below the upland points to a time when the river once occupied that level; and the winding course of the river would plainly show that the river had, before this uplift, been near enough to sea level to wander in broad curves over its flood plain. And the story of an interrupted cycle is written in language as plain as could be desired.

Summary.—It will thus be seen that a river, while it may be "a stream of water running thru the land", while it may be "water and waste on its way to the sea", is in addition a worker of most prodigious energy, both as a carver of its own valley and a carrier of its own waste; that in its work, it adjusts and readjusts its forces so as to do the greatest amount of work in the most efficient manner, showing a delicacy of mechanism, which like the laws of light, heat, sound, and the law of gravitation, brings one a realizing sense of the infiniteness of the world and the fact that "Man's conception of the world must ever remain a relative term." It will also be seen that the work of rivers is subject to interruptions and consideration of these interruptions is necessary to a clear understanding of land forms along their banks.

This article makes no attempt to be an exhaustive treatment of the subject of rivers. Such a work would fill a good sized volume. The attempt has been to strike at the most salient features in the life work of rivers and give a very general discussion of the way in which their life work is done, to the end that there might be given a somewhat broader conception of a river's scope and a more sympathetic study of the "most human and companionable of all inanimate things".

THE PHYSIOGRAPHIC FEATURES OF MARYLAND: THE APPALACHIAN PROVINCE[1]

(Continued from page 248)

BY CLEVELAND ABBE, JR., ROCK HILL, S. C.

Boundaries of the Province.—The Appalachian Province of Maryland embraces what is commonly known as Western Maryland. The eastern boundary of the province is formed by Catoctin mountain, while the western limit is artificially defined by the western boundary of the state, altho topographically and structurally the province continues westward until it merges gradually into the lowlands of the Ohio drainage. To the north and south the topographic features of the province reach far beyond the limits of our state. The broad lowland of the Great Valley and the many parallel, even-crested ridges with intervening valleys, which are so characteristic of the province, extend from central Alabama and Georgia northward thru Maryland and across Pennsylvania until they disappear in the plateau country of southern New York.

General Topographic Features.—The topography of the Appalachian Province is more varied, more picturesque and grander than that of either of the other two provinces. In its eastern part the broad and somewhat serrated crests of the Blue Ridge and Catoctin mountains overlook the broad, gently rolling floor of the Cumberland or Hagerstown valley, which is watered by Antietam and Conococheague creeks, streams of some size that have sunk meandering trenches to depths of seventy-five or eighty feet below the general level of the valley floor.

Beyond the Great Valley may be seen the long, even crest of North Mountain. This strongly marked topographic feature is the most easterly of a series of long, parallel mountains running northeast-southwest and alternating with long, narrow valleys. These

[1] For boundaries and sub-divisions of this Province see map on page 152 of this volume of the Bulletin.

ridges and valleys are the chief topographic features of the district between the Great Valley and Dans Mountain west of Cumberland. They are termed the Appalachian Ridges and have been classed under that name as one of the sub-provinces of the Appalachian Province on the outline map. Beyond these ridges, which gradually increase in height westward, the general surface spreads out as an extensive upland or plateau with an average elevation of 2,500 feet, from which parallel ranges of mountains rise.

The Present Structure of the Province.—In describing the Piedmont Plateau it was pointed out that its topography was closely related to the geology. The Appalachian Province shows in a yet more striking manner this relationship between geology and topography since the winds, rains and rivers have been at work for ages etching out the mountains and valleys along the lines determined by the structure of the country. The hills and the mountains all indicate by their parallel arrangement and N. E.-S. W. trend that the resistant rocks cross the state in the same direction, while the valleys tell the same story about the location of the less resistant formations. A cross section of this Province shows that the strata have been thrown into folds whereby at certain points hard resistant conglomerates and sandstones have been brought to the surface, while at other points they have been thrust deep down and only the more yielding rocks above them appear. Many of the smaller ridges and even elevations such as Wills Mountain, mark lines along which some hard, resistant stratum has been arched up. Such ridges have their general cross profile determined by the arched strata which maintain them. Other prominent ranges, such as the Blue Ridge, owe the elevated position of their resistant rocks to great dislocations along which the rocks have been thrust up above their earlier positions.

Between the original ridge-forming folds or anticlines there were valley-forming troughs or synclines, in which it is probable that the rains gathered and formed streams which would be classed as consequent. Today a number of small streams occupy similar positions among the ridges and mountains of Washington county. It is not likely, however, that these present streams have inherited their courses from consequent ancestors. On the contrary, since the synclinal troughs are occupied by yielding shales, it is much more likely that the streams took courses immediately above their present locations during the time when this whole district was

being reduced to the general surface of the Schooley or Cretaceous peneplain. During that period of erosion the summits of the present hard ridges appear to have acted as guides directing the streams to develop along the more easily eroded strata of the synclines. In many cases the arches of hard rock originally rose so high above sea-level that they were truncated by the broad, gentle surface of the peneplain, as it was gradually but irresistably extended across the folds. The domes of rock were thus completely unroofed and their cores of softer rocks became exposed to the attacks of the elements. Guided by the easier paths thus opened, certain rivers extended their courses, not along constructional troughs or synclines, but along the axial lines of the arches or anticlines. Along the axis of a comparatively broad flat anticline in Garrett county the two branches of the Savage river have thus opened the broad depression lying between Savage and Meadow mountain.

Original Structure.—The gradual change from the much disturbed strata of Washington and Allegany counties to the almost horizontal arrangement of the same strata in the plateau districts of Garrett county and of West Virginia, serves to remind the observer of the original positions of these beds. The successive layers of finer and coarser materials, the remains of animals and plants, and the close resemblance between many members of the series and various deposits which may be seen forming today, all point to the conclusion that these strata were deposited in succession over the floor of some very ancient sea. All the present dislocations of those ancient strata are the products of folding and faulting under compression, which came after the rocks were laid down as horizontal beds of clays, sands, and calcareous muds at the bottom of the interior Paleozoic sea.

The Appalachian and the Coastal Plain Structure Compared.—The strata now forming the Appalachians were deposited in more or less proximity to a shore or coast which lay along the eastern limits of that ancient sea. The general location of this ancient land area, as indicated by the sediments derived from it, seems to have been in the district now occupied by the eastern Piedmont Plateau and western Coastal Plain province. In the period during which the Paleozoic strata were deposited this province was a more or less lofty land area, whose rivers flowing westward, carried down large quantities of detritus to the sea. As the amount of materials thus transferred from land to sea floor increased, the sea itself

would have been largely filled up had not the lands beneath the sea gradually subsided. In this way there was accumulated the great series of Paleozoic strata which stretched far westward from the coast of that time.

If now the strata deposited in this Paleozoic sea are compared prior to their dislocation, with the present Coastal Plain series, several points of resemblance, particularly as regards origins and relations to the mainland, may be pointed out. Both the Paleozoic and the Mesozoic-Cenozoic sediments were deposited in seas often comparatively shallow, but which, altho constantly filling with new materials, were also for a while gradually deepening, thus continuing the period of deposition. Both series of sediments were derived not only from areas immediately bordering the respective basins of deposition, but also in part from precisely the same region, namely, the Piedmont district. These comparisons show that during long periods in geological history the Piedmont region has been supplied with a Coastal Plain.

Topographic Subprovinces.—It is clear from the general description of the Appalachian Province given above, that a fourfold subdivision is possible on the basis of the topographic types represented. These subdivisions from east to west may be designated as the Blue Ridge, the Great Valley, the Alleghany Ridges and the Alleghany Plateau.

The Blue Ridge.—The physiographic subprovince here designated by the name of the Blue Ridge includes the Blue Ridge proper, the Catoctin mountain and the district lying between them. Blue Ridge proper, which forms the western boundary of the subprovince, is a long, straight ridge with slightly uneven and knobby crest maintaining an average elevation of two thousand feet above tidal level. It starts in Pennsylvania as a portion of South Mountain, passes southward thru Maryland and after declining somewhat on each side of the Potomac gorge at Harper's Ferry, rises again in Virginia to a somewhat lesser elevation. That portion which lies within the limits of Maryland owes its crest line altitudes to the superior resistance of the Lower Cambrian or Weverton sandstone which reached its present elevation partly as the result of a great overthrust fault, partly thru more recent elevations of the whole of the Appalachian district.

Altho subsequent denudation has carved numerous scars and slight sags in the crest of the Blue Ridge, except for the narrow

defile of a small branch of Antietam creek debouching at Leitersburg, the Ridge presents an unbroken crest from Gettysburg Gap on the north to the deep gorge of the Potomac at Harper's Ferry. The western slope of the Blue Ridge divide has the greater relief, its summit rising about 1,500 feet from the level of the Cumberland or Hagerstown Valley. The contours of this slope are generally precipitous along its upper zones. Over the lower portion they become much softened, however, and grade into low, rounded foothills which mark the outcrop of a band of fissile shales, Harper's shale, lying between the quartzite and the limestone. The eastern slope of the South Mountain is much milder in slope than is the western face for two reasons: First, because the capping sandstone dips eastward, and second, because there is but slight difference between the resisting powers of this sandstone and of the volcanic rocks lying against it on the east.

East of the Blue Ridge proper, and almost parallel with it, runs the straight and slightly undulating ridge called Catoctin mountain, which forms the eastern boundary of the Blue Ridge subprovince. Its prominence is due to the greater resistance of the heavy Cambrian quartzite, which has withstood the attacks of the elements more successfully than the rocks on either flanks. Again it is with the Catoctin as with the Blue Mountain, that that slope which descends to the yielding rocks of the broad valley lowlands, is the longer and the more precipitous, while the opposite slope is the milder and the shorter. Here, however, the valley lowland is that of the Frederick or Monocacy valley carved out on the Frederick limestone and the Newark formation. This lies to the east of the ridge, while the shorter and milder decline forms the western slope.

Turning now to the valley included between the two crests just described, it is found that this portion of the Blue Ridge subprovince has a number of peculiar and interesting features. It attains its best marked and most characteristic development in the southern portion of the district, in the drainage basin of the Catoctin creek, and is less characteristically a valley in the northern half of the area which is drained by the Monocacy and Antietam tributaries. In spite of the fact that nearly half of the drainage basin of Catoctin creek is underlain by igneous rocks, like granite and quartz porphyry, and the remainder by the still more resistant Catoctin schist, the stream has reduced a considerable portion of

its basin almost to a base-levelled state during a geographically recent period. Starting with an average elevation of about five hundred feet over that portion of the valley lying along the Potomac, the old valley floor may be traced northward a little beyond Myersville, where it has reached an elevation of about 750 feet. A considerable part of this rise is accomplished within the last ten miles where it is accompanied by a growing irregularity in the old valley surface. This gradual change in perfection of modelling is what would naturally be expected over the up-stream portion of an old valley, since the lower portions of a stream's course are always found to be reduced more perfectly and uniformly than are its up-stream limits. Beyond Myersville the traces of this old valley floor are quite lost, if the feature ever existed there. Below the more or less even surface of what may be called the five hundred foot level, the Catoctin and its tributaries have incised their channels to depths up to a hundred feet, according as they are farther from or nearer to the present local base level, the channel of the Potomac river. Above the general five hundred foot level there remain a few areas not wholly reduced. These are more numerous along the sides and particularly at the head of the basin where they gradually merge with that portion of the area which never was reduced to the five hundred foot plain.

The northern portion of this district, lying between the crests of South Mountain and Catoctin, seems never to have been reduced to such a valley lowland as formerly existed along Catoctin creek. The combined action of the resistant rocks to the north, and the superior powers possessed by the headwaters of Catoctin creek working up from the south has, so far, resulted in confining the drainage of the northern streams within comparatively narrow bounds. Altho the volumes of the latter streams have thus been limited to such meagre proportions, small subsequent streams and valleys along the comparatively yielding quartz-porphyries have been developed, and today there may be seen green, level-floored, narrow valleys winding in and out among numerous bluntly conical hills or long ridges. Below these valleys, particularly near the mountain fronts, the torrent-like streams have often cut steep, wild gorges.

The Greater Appalachian Valley.—The Greater Appalachian Valley embraces all the country lying between the Blue Ridge on the east and Dans Mountain or Alleghany Front on the west, and

thus has a width of about seventy-three miles. As has been noticed above, the Greater Valley admits of a two-fold sub-division into the Great or Cumberland Valley on the east and the zone of the Alleghany ridges on the west.

The Great or Cumberland Valley is the rather broad, even depression lying between the Blue Ridge on the east and the North Mountain on the west. This broad fertile valley, sometimes known as the Hagerstown Valley where it passes thru Maryland, is a marked topographic feature thruout the whole extent of the Appalachian province.

The principal topographic feature of the Great Valley is its broad, gently rolling floor. Altho this floor is now much cut up by minor drainage lines, its formerly almost level surface has given the present hills very strikingly accordant elevations. So nearly coincident are the various heights that if a flat board floor could be laid across the valley, it would be supported by almost every hill and would have an altitude of about six hundred feet above sea level. Long divides with broad tops maintain this average elevation over considerable distances, and are generally occupied by highways. There is a slight descent from the northern boundary of the state to an elevation of from five hundred to 550 feet along the Potomac, which brings this former plain into relation with the plain along the Catoctin creek and the Monocacy river.

The principal streams draining the Maryland section of the Great Valley are Antietam and Conococheague creeks, both of which rise in Pennsylvania and flow southward thru Maryland to the Potomac. The valleys of these streams are deep, narrow and steep-sided, that of Conococheague creek being particularly gorge-like in character. The streams themselves are rather rapid and have not yet reduced their channels to even grades, as is shown by the low ledges of shales and limestone which sometimes interrupt their flow. The courses of the channels are tortuous, often quite meandering, and these turns and twists are always followed by the gorge walls. This fact indicates that the streams originated their meanderings on the flood-plains which accompanied them when the present dissected valley floor stood at a lower elevation and these streams flowed upon its continuous surface. As the area was elevated the streams began to cut down along their courses, always keeping a little behind the Potomac, as it deepened its channel. Thus the winding courses which the streams followed on their

earlier flood-plains became impressed upon the limestone and shale beneath, and these more resistant rocks still retain the streams in their old courses which are described as inherited or superimposed.

The general characteristics of the Alleghany Ridges have already been briefly sketched. Several of these ridges are due to the up-arching of resistant sandstones which have withstood the attacks of the elements, while the yielding rocks which covered them have given away. The best examples of such prominences are found in Wills Mountain, Martin's Ridge, Warrior's Ridge and North Mountain. The dome of the arch in the latter case has been partly removed, however, and the yielding shales beneath, which were formerly protected, are now rapidly giving away. There is thus forming a shallow and elevated valley along the axis of the up-lifted trough. All of these mountains rise very nearly if not quite to the two thousand foot level.

Other crests, such as those of Town Hill, Sideling Hill, and Tonoloway Hill, fail to reach this height by about five hundred feet. They owe their elevation to the fact that, in a number of cases, the Carboniferous conglomerate or sandstone was depressed below the general level of the Schooley peneplain, and thus escaped being worn away during the production of that feature. Subsequent elevation and erosion have removed the softer rocks, which were then exposed by the unroofing of the arches or anticlines; and these small synclinal remnants of the hard sandstones now stand out in relief as protecting caps to the yielding strata just beneath them. Thus what may have been, originally, a series of constructional synclinal valleys has been converted into a set of parallel even-crested ridges with synclinal summits.

Between these mountains and ridges comparatively broad, even-floored valleys were at one time carved out by the streams which had reached the anticlinal arches during the Mesozoic era. For so long a time did the land stay at rest after the elevation of the Schooley peneplain that these streams reduced their valleys to very gentle slopes, even far back in among the ridges. Sufficient time, however, was not allowed for the reduction of the ridges also, as was the case during the preceding cycle. It was at this time that the level floor of the Great Valley was produced, the general surface of which can be followed in and out among these western ridges. This generally even and accordant surface is often referred to as the Shenandoah Plain, because it is so typically developed

over the yielding rocks of the Shenandoah Valley. Having been developed only in the vicinity of the streams, the Shenandoah Plain is found to rise gradually as it extends towards the headwaters of the various mountain streams of the central district. The general elevation, however, is somewhat greater and the inclination of the surface steeper than would be the case if due simply to the normal stream slope of the region. These features are believed to be due to a general but unequal elevation of the land after the Shenandoah Plain has been developed. This elevation, or more strictly speaking, warping, was greatest along a northeast-southwest axis located near the eastern boundary of the Alleghany Plateau, and also along a minor axis running southwestward from southern Virginia and West Virginia, the influence of which was extended as far northward as Maryland and eastward to the Atlantic coast line, affecting to some extent the district of the Alleghany ridges.

The warping of the Shenandoah Plain exerted a marked influence upon the development of the well-adjusted streams of the Appalachian district which, at the close of the period of denudation, were meandering over comparatively broad flood-plains. The elevation which succeeded the period of denudation revived the activities of the streams, and they rapidly deepened their channels, cutting narrow winding courses, taken from their former directions on the Shenandoah Plain. Continued denudation has now worn away considerable portions of the inter-montane region, so that its general surface can be traced only in the long, flat inter-stream areas and the rounded crests of those hills which rise to the general level of the plain.

Among the most characteristic remnants of this formerly extensive surface may be mentioned Shriver's Ridge, with an elevation of 1,071 feet; the northern spur of Knobbly Mountain across the Potomac river, with an elevation of 1,115 feet; the heights northeast of Cumberland, with an average elevation of something over one thousand feet; and the broad, dissected district extending northward from Old Town, which is drained by Big Spring run and Town Creek, with an average elevation of about nine hundred feet. The character of the gorges which the streams have cut below the uplifted Shenandoah Plain clearly shows that the rate of elevation was not uniform. At least three distinct terraces can be made out along the banks of the Potomac

in the vicinity of Cumberland. Each terrace indicates a period of temporary quiescence for the land, during which the stream was able to expend some of its energy in the horizontal cutting and widening of its channel; while each slope from a higher to a lower terrace indicates a period of renewed activity in vertical down-cutting. The two upper terraces belong to the class of stream-cut terraces, as is shown by the fact that their almost horizontal tops are bevelled across the upturned shales. Only a very thin layer of scattered cobbles and gravels is found on either terrace. The lower terrace is so heavily covered with river deposits of sand, gravel and boulders that it is difficult to say whether it is a cut or a built terrace or a combination of both. These terraces, particularly the two lower ones, may be followed down the Potomac beyond Harper's Ferry, running in and out of the stream valleys which join that river from either side and gradually declining in elevation. Up-stream they have been traced as far as Keyser and undoubtedly extend a considerable distance further. Attempts have been made to correlate these terraces with contemporaneous epochs of deposition contained within the Coastal Plain series, but very recent work in that group of deposits by the New Jersey and Maryland surveys has so altered former conceptions of stratigraphic sequences and conditions of deposition that it seems best for the present at least not to attempt a statement regarding the stratigraphic equivalents of these features.

The Alleghany Plateau.—The Alleghany Plateau extends from northern central Alabama, where it is known as the Cumberland Plateau or tableland, northward and eastward thru Tennessee, Kentucky, Virginia, West Virginia, Maryland and Pennsylvania into New York, where it forms the high lands covering the southern half of the state from the Catskills to Lake Erie. This plateau, which preserves, in its general level, the largest continuous areas of the Jura-cretaceous, or Schooley peneplain, is not characterized by a broad, unbroken expanse, but has been so deeply dissected that only the even crests of isolated ridges remain to indicate the former extent of the plateau. Standing on some lofty central point, such as the crest of Keyser's Ridge in Garrett county, one may see all about him these long level-topped crests which seem to rise very nearly to the same height, altho there is a gradual decrease in elevation northward and eastward from the district between Savage Mountain and Keyser's Ridge. The long ridges are

arranged in almost parallel ranks and follow the broad curves of the Appalachian system, while their even crests are the present representatives of that broad peneplain which has already been referred to in dealing with the eastern portions of Maryland. The most representative elevations of the peneplain in this district are found in Savage Mountain, which has an altitude of about three thousand feet, in Keyser's Ridge and Negro Mountain, with elevations of three thousand feet, in Winding Ridge three thousand feet, and Hoop Pole Ridge 2,800 feet. These elevations are the culmination of the westward rise of the Schooley peneplain in the latitude of Maryland. Farther westward the general surface gradually declines to the Ohio and the Mississippi rivers. Within the Maryland portion of the plateau the strata are still gently folded, so that the extension across them of the old peneplain surface here, also, resulted in the removal of several rock domes. Thus, while the land was being reduced to very mild topographic forms, the way was being prepared for the easy carving out of lofty mountain ranges during a subsequent time. As a result of the elevations which have taken place since the Schooley peneplain was produced, the streams which have developed on that surface and whose courses were adjusted to its underlying structure, have deepened their valleys considerably. There were other streams, however, which, altho they occupied courses located on yielding rocks, had carved their valleys out along synclinal axes and have not since their elevation materially deepened their valleys.

There are thus seen to be two classes of valleys and streams within the boundaries of the Maryland portion of the plateau, one class has synclinal or consequent streams and valleys, the other class embraces the subsequent or anticlinal streams. The characters of these two classes of valleys are quite as distinct as are their relations to the structure. The subsequent streams have developed their courses generally along Jennings and Hampshire shales, which formed the cores of anticlines whose domes were roofed by the resistant Pocono sandstone. The elevation which interrupted further development of the Schooley peneplain gave all these streams increased activity and they began to actively reduce their valleys to the new base-level.

Today the new valley-floors thus produced may still be seen as flat-topped hills of Hampshire and Jennings shales bounded by steep and often precipitous cliffs which are capped by rocky crags

of Pocono sandstone. Perhaps the largest area covered by this surface of denudation is to be found in the vicinity of Accident. This town is located near the centre of a broad amphitheater, whose boundaries are the curving Pocono-capped crests of Winding and Keyser's ridges, and whose floor is a very gently rolling surface, large portions of which remain over the inter-stream areas. This is the old floor produced just after the elevation of the Schooley peneplain. Numerous disconnected areas along the northwestern flanks of the Savage river valley also preserve this surface. Turning to those streams which pursued consequent or synclinal courses, it appears that instead of occupying deep valleys with steep bounding slopes, their valleys are comparatively shallow and stand at higher levels than do the subsequent valleys. The best example of this class of streams and valleys is found in the valley of the Castleman river. This stream is located on that portion of the Fairfax formation or Barren Measures, which reposes in the synclinal basin between Meadow and Negro mountains. The valley is very broad and comparatively shallow, especially at the southwestern end of the syncline, and there is no sudden break in the slope from the crests of the two limiting mountains to the axis of the valley. The reasons why the streams draining such valleys as that of the Castleman river have never been able to reduce those valleys successfully is due to the fact that the whole valley is floored with a resistant conglomerate or sandstone, which must all be removed before the mountain can be lowered.

Just here it may not be amiss to refer to those broad, wholly enclosed valleys whose meandering streams are often bordered by rather marshy ground. Such valleys are known in Garrett county as "glades", while any valley which has steep bounding slopes and slightly marshy flood-plain is called "glady country." These poorly drained areas are calculated to attract attention in a district where the sharp relief of the country in general insures unusually well-drained soils. To one familiar with the poor drainage of the glaciated districts of the United States, glaciation at once offers itself as an explanation of this topography. There are, however, none of the other signs of glaciation, such as transported boulders, striated ledges or morainic material. They may be more rationally explained as products of long continued stream-action limited by very resistant local baselevels of Pocono sandstone.

So far the Maryland streams of the Alleghany Plateau have

been considered from their purely local relations. It is interesting to consider briefly their general relations to the broad structural features of the region. From this point of view, also, there are two classes of streams here: First, those which flow westward down the general dip of the strata to the Ohio, and second, those which flow eastward against the general dip to the Atlantic. The Youghiogheny and Castleman rivers take out all the Ohio drainage, while the Savage and the North Branch of the Potomac lead off the waters which flow into the Atlantic. It has already been pointed out that the whole Appalachian district formerly bore the relation of a coastal plain to a land area lying somewhere to the east. In the view of this fact all the rivers should naturally flow westward down the inclination of the strata towards the old sea. As a matter of fact, only the Youghiogheny and the Castleman approach to this arrangement, while the Potomac and its tributary, the Savage, go in directly the opposite direction. They even do more, for they cut across what we can see of that old land area and empty into the Atlantic at a point where formerly there may have been hills.

General Topographic History of the Province.—The topographic history of the Appalachian Province may be briefly summed up as follows: The Province originated as a coastal plain along the western shores of some ancient land area, part of which may be represented in the ancient crystallines of the Piedmont Plateau. Probably a short time before the close of the Paleozoic this coastal plain was elevated and deeply folded in its eastern portion by powerful compression. This elevated and corrugated coastal plain then suffered a partial reversal of its westward flowing drainage, and remaining for a great length of time in a quiescent state, was so far reduced by erosion as to attain the mild features of advanced topographic maturity and perhaps even become a peneplain. This period of repose was closed by a decided warping of the new surface, that raised it to an elevation of about two thousand feet in Western Maryland, but only to about three hundred feet in the central portion of the state. Then followed another period of repose during which the Shenandoah Plain was carved out. Finally a series of elevations at irregular intervals has warped the two plains still further, bringing the Schooley peneplain level to altitudes of three thousand feet in the western and five hundred to eight hundred in the central section of the state, while the Shenandoah Plain stands at one thousand feet to 1,500 feet in the west

and five hundred in the central district. The latest elevations have caused the streams to cut below the level of the Shenandoah Plain a series of steep, terraced gorges that they are still deepening.

A SERIES OF LESSONS LEADING TO LAPLACE'S NEBULAR HYPOTHESIS

BY THEDA GILDEMEISTER, WINONA. MINN.

These lessons may easily form the entire course in "Nature Study" for the winter months, when animate nature is not easily accessible. They have proven themselves especially valuable in fifth and sixth school years, but should, of course, be given to the grade whose geography work requires these topics.

If time were limited, topics II, III, and IV, below, could be omitted, but the study of all forms of attraction and their opposing forces touches so many other geographical topics, that as complete a course as here outlined seems advisable.

A plan has been made by which this course is succeeded by one upon "The Growth of our Earth" in which it is easy to emphasize the continents' formation, the glacial period, the coal epoch, etc.

The general plan of the lessons is as follows:

FORMS OF ATTRACTION.

I. Magnetism.
II. Static Electricity.
III. Adhesion and Capillary Attraction.
IV. Cohesion.
V. Gravity and specific gravity.
VI. Gravitation—the universal attraction.

NEBULAR HYPOTHESIS.—LAPLACE.

The lessons are begun with "Magnetism" because it is a form of attraction well known to children and because the *action* of the force can so easily be seen.

LESSON I. MAGNETISM

AIM: To show that "Magnetism" is a valuable force in Nature.

PREPARATION:

1. *Material.* Teacher has ready a good map of the world; several magnets; various metals, ores, and stones; articles made of various substances, e. g., needles, pins, steel tacks, copper tacks, toy ducks, knives, etc.; a magnetized "needle"; a compass; iron filings; a basin of water; money made of copper, nickel, and silver. If possible, have the most of these articles on a table and with a cover thrown over all.

2. *Children's Minds.*—Teacher may say, "I see by your faces that you are exceedingly anxious to know what is under the cover on that table, and in a few minutes you shall know. We are to make some *experiments* (teacher writes word on blackboard) today, and I wonder whether you know what an experiment is." Teacher secures the definition and has written upon the board "An experiment is a trial." Do you know *why* people make experiments? (To find out new things, or to prove old facts, or to discover reasons for known relations.)

Who make experiments? (All people, and in all occupations; e. g., the cook experiments every day. She "tries" the effect of more butter, sugar, or salt. She creates new dishes. The merchant tries the effect of various forms of display in his window. We experiment with a new ribbon, or a new hat, or a new way of dressing our hair, etc.) Think of all you can. But these experiments which we have just mentioned benefit only a few people, whereas there are men who are continually experimenting upon things that will benefit all mankind. It is due to these men that we have gas and electric lights in our homes, that farmers can mow, bind, and thresh their grain so easily, that we can telegraph or telephone to our friends, etc., etc. Think of as many such results of experiment as you can. Do you know the name of one famous experimenter now living in our country? (Thomas A. Edison.) Do you know any others who have lived here? (Franklin, Eli Whitney, Fulton, Goodyear, Morse, etc.) (Children have probably read, "Stories of Great Americans for Little Americans".)

Today we are going to make some experiments to prove to you some facts already known by older persons. (Teacher uncovers table.)

PRESENTATION: Outline of work.

1. Magnets shown and handled.

(*a.*) Name. (*b.*) Reason for name. (*c.*) Sort first found. Qualities shown. (*d.*) Other name (lode-stone). Why? (*e.*) Kinds. Natural, Artificial. How Made? (*f.*) Poles.

2. Other apparatus discussed. Composition, etc.
3. Experiments.

(*a.*) With various metals, stones, toy ducks on water, money, etc. Lay in separate groups the objects which the magnets attract readily, slightly, and not at all. (*b.*) Make knives, needles, etc., into artificial magnets. (*c.*) Show how a magnet influences the suspended magnetic needle.

4. The earth as a magnet.

(*a.*) Children told of this and of how the needle stands in an almost vertical position at Boothia Felix, Baffin's Bay, showing the proximity of the magnetic north pole. Use map. (*b.*) Children told of what occurs south of the magnetic equator. (*c.*) Of the east and west declination. (*d.*) Mariner's compass. Use to sailors. "Dip" of the needle. "Declination" of the needle.

Suggested questions and work on the above outline. (Numbers and letters will correspond.)

1. (*a.*) Every pupil knows the name of this instrument, but can any of you write its name on the board?

(*b.*) Do you know why it is so named? Point to Asia on this map of the world. Find the division called Asia Minor, which means "little Asia". At about this point (teacher shows if name is not on map) there is a little town called Magnesia, (write on board) and it was near this town, many years ago, that the first magnets were found. Compare "magnet" and "Magnesia" as to spelling. Now tell *me* why this is called a magnet.

(*c.*) The first magnets found were simply pieces of iron ore which had the peculiar property of drawing towards themselves pieces of iron and nickel.

(*d.*) Somewhat later it was found that when hung by a thread and thus left free to move, bar-like pieces of this iron ore would point in one direction, viz., slightly west of north, and that if disturbed, the bar would resume its northwesterly position. Sailors could thus find the directions without other means, and they called this ore the "leading stone", changed later to "lodestone" and to "loadstone".

3. (*a.*) After children have experimented with the various metals, stones, etc., they ought to examine the different groups and the conclusions reached will be one of the "generalizations" of the lesson, viz., Magnets attract all substances containing iron, steel (a form of iron), and nickel. (The teacher may care to know that cobalt and liquid oxygen are also attracted, and that Faraday proved that *almost all* substances are influenced—either attracted or repelled—by a magnet, if one powerful enough be employed.)

(*b.*) Artificial magnets seem to be temporary. Let the children test their knives and needles upon succeeding days. However it has been proven that the power is never entirely lost, and careful handling will cause a longer retention of the magnetic power. That this loss may be reduced to a minimum, magnets have been made of successive plates, rather than of one solid piece of iron or steel. (See any good text.)

(*c.*) Study the suspended needle. If none is obtainable, make one by first magnetizing a knitting or a darning needle and hanging it by a silken thread. It will turn to the north, with a very slight "dip", and a "declination" to the east (if in the Mississippi valley or west of here).

Place a magnet near it and watch it "draw near" at times and "fly away" at other times. Mark the end of some needle or of a bar-magnet which attracts the north-pointing end of the suspended needle. Then suspend this one and see whether the marked end points north or south. Try several, if time permits. Name the poles of any magnet north and south, as they point north and south. Of two magnets, which poles attract each other? Which repel?

4. (*a.*) There must be some reason why a suspended needle invariably points towards the north, and scientists have found that this earth on which we live is a great magnet and that it, too, has two magnetic poles near, but not coinciding with, the geographical poles. The farther north the needle is carried, the more it "dips", until, if we could reach the exact magnetic north pole, the needle would become vertical. Show children the approximate location.

(*b.*) South of the magnetic equator, which is not exactly coincident with our geographical equator, the south pole of the magnet dips.

(*c.*) Since the magnetic and geographical poles do not correspond, the respective meridians could not coincide; and we shall

therefore find that in Europe and in North America the "needle" does not point the same way. Explain to children. Refer to the fear of Columbus' sailors, when the change in declination was noticed.

(*d.*) Show compass and its use. Tell of instruments which enable sailors to find their exact longitude, even tho the needle varies.

ASSOCIATION AND COMPARISON: Associate name "magnet" with town of "Magnesia" and fix its geographical location. Associate name "lode-stone" with its "leading" qualities—"leading" of iron and nickel compounds, and "leading" of sailors. Compare the strength of the magnet's poles with its center as to power of attraction. Compare the poles and center of the two broken pieces of a magnet. Associate the "dip" of the needle with latitude; the "declination" with longitude.

GENERALIZATION: Of course the main generalization is the accomplishment of the aim, viz., the children see that *magnetism is a very useful force in nature.* But there are many minor generalizations leading to this, and the children should be held for them; viz.,

1. An experiment is a trial.

2. Experiments are made (*a*) to discover new truths, (*b*) to prove old truths, (*c*) to discover causes for certain relations.

3. Magnetism is an invisible force. We see only the results, not the force itself.

4. Magnets attract all compounds of iron and nickel.

5. There are two kinds of magnets, natural and artificial. Artificial magnets are of various shapes, usually bar or horse-shoe, however.

6. Every magnet has two poles, opposite in attractive tendency. If broken, each piece immediately becomes a complete magnet, with two distinct poles.

7. Unlike poles of different magnets attract each other, and like poles repel.

8. The poles are first named north and south poles according as they point north and south when suspended. (Teacher may here explain that each is *not* always suspended, but is tested with a marked magnet. Let children think this out, if possible, and let them see how the poles should then be marked. In France, the scientists argued that since the earth is a magnet, the north pole

must attract the *south* end of the needle and so they named it thus. But the English and Germans named the north-pointing pole *north.* Perhaps it is as well not to *tell* children this, but should they *ask*, teacher may be glad to know.)

9. The earth is a magnet.

10. The earth's magnetic power makes the compass possible. The compass enables mariners to keep their "bearings" in all sorts of weather.

APPLICATIONS: For immediate application, teacher may base a spelling or a language lesson upon the above. Or a written test may be given, asking such questions as:

1. What is an experiment?
2. Why do men make experiments?
3. Name at least three famous experimenters and tell one result that each accomplished.
4. With what apparatus did we experiment today?
5. What is the name of the instrument we used in making each test? Why was it so named? Had it any other name? What? Why given it?
6. (If an oral test,) Point to Magnesia on the map. Walk towards Magnesia.
7. What did the first magnet resemble?
8. What things did we find our magnets attracting?
9. Are all magnets found in the earth? What proved your answer? (Children could say, "We made some magnets of needles and knife-blades, in class.")
10. What is the largest known magnet?
11. What proves that it is a magnet?
12. How is its magnetic power useful to man?
13. Locate the earth's magnetic north pole (approximately).
14. What is magnetism? Etc., etc.

The author wishes to say that altho this is given as one *lesson*, it is meant to cover several *recitation periods*, of perhaps twenty minutes each. The preparation alone would probably occupy the first recitation, in which case the introductory sentences would, of course, need changing. The examination and discussion of objects and materials, with the "Experiments" thru (*b*) would probably make the second recitation. Thru 4(*c*) would make a third, and the compass, alone, would make a fourth recitation. The last three

formal steps would also be subdivided to correspond with the divisions of the "Presentation".

Good references: Sylvanus P. Thompson's "Elementary Lessons in Electricity and Magnetism", H. S. Carhart's "University Physics", and Oliver Lodge's "Modern Views on Electricity".

LESSON II. STATIC ELECTRICITY

This next topic in the outline is given because it shows another form of attraction, which, like magnetism, acts between comparatively large bodies (masses) and when these masses are not contiguous.

References: Silvanus P. Thompson's "Elementary Lessons in Electricity and Magnetism", J. D. Steele's "Fourteen Weeks in Physics", and J. B. Gifford's "Elementary Lessons in Physics, Teachers' Edition".

AIM: To show pupils a second form of molar attraction, and to give its name.

PREPARATION:

(*a*) Review previous lessons on Magnetism, especially emphasizing the fact that magnetism is a *form of attraction.*

(*b*) Materials prepared for advance work. The teacher may secure as many of the articles named in each list as she can, or as she deems desirable.

Group 1.—Rubber ruler; rubber comb; ebonite; glass rod; glass lamp-chimney; piece of resin; piece of amber; stick of sealing wax; a jet ornament or button.

Group 2.—A soft silk handkerchief; pieces of flannel; pieces of fur, especially cat-skin.

Group 3.—Exceedingly small pieces of paper; cork; shavings; chips; elder pith; corn pith; feather, or down, and straw (chopped). Also some iron-filings; chaff; bran; dust, and sand; some empty and dry egg-shells; some pith-balls, tied by silk cords to the end of a wire, the other end of which may be put into the cork of a bottle. Also some pieces of silk ribbon and a warm flat-iron.

Let pupils handle all of the above substances and grow familiar with their names and general characteristics. To succeed best, this work should be given on a bright, clear day, and in a dry atmosphere.

PRESENTATION: Let as many different pupils as possible perform

the various experiments. Let others make notes and observations in note-books, for later discussion.

Experiment 1. Vigorously rub each of the objects in group one with one of the objects in group two and then hold it near some of the objects in group three. (This means as many experiments as the teacher has materials for.)

Observations: Which substances are attracted? Which not? Are they like those attracted by the magnet? Have the sealing-wax, etc., a permanent power of attraction? What creates in the substances of the first group this power of attraction? What better name have we for this "rubbing"? (Friction.) (The teacher here explains that we say "the sealing-wax is *excited* by friction.") Did we use friction in any of our experiments upon magnetism? What was the result? (We gave the power of magnetism to our knife-blades, needles, etc.) For how long did the knife-blades retain their magnetic power? How long do the sealing-wax, rubber, etc., retain their attractive power?

Experiment 2. Briskly pass the rubber comb several times thru the hair. Watch the hair as the experimenter prepares to pass it thru again.

Experiment 3. Again excite the comb in the same way. Hold it near some tissue-paper strips or rings, or near some empty egg-shells.

Experiment 4. Excite the glass tube or the lamp-chimney by friction. Hold it near the cheek. What do you feel? (A slight tingling sensation, as if fine hairs or a cobweb were blown across the face.)

Experiment 5. Excite the rubber ruler. Let another person carefully take hold of one end and lightly touch the tip of the finger to the other end. What is seen? What heard? What felt?

Experiment 6. a. Hold silk ribbon near a wall. Lay it on a flannel-covered press-board. Lift it. *b.* Quickly run a warm iron over the ribbon as it lies on press-board. Lift it. Hold it near wall. Observe everything closely. (If warm iron is not convenient, draw the ribbon quickly thru two warmed pieces of flannel.)

Experiment 7. Excite the glass tube. Hold it near a downy feather. Let feather touch the excited tube. Observe. Drive feather about room for some minutes, being careful not to let feather touch any object. Then let feather fly against some object. Try the effect of the tube again.

Experiment 8. Excite any one of the objects in group one, the rubber ruler, e. g. Hold it near the suspended pith balls. Observe. Let balls touch the end of ruler. Observe their action now.

Experiment 9. Excite the glass tube and perform experiment 8 once more. Now excite the sealing-wax. Hold near the balls. What happens?

Experiment 10. Hold the excited glass tube on one side of the pith-balls and the excited sealing-wax on the other. What occurs?

Experiment 11. Try experiments 8, 9, and 10 with some tissue-paper tassels, suspended as are the pith-balls.

Experiment 12. Excite a stick of sealing wax and suspend on fine wire frame by silk thread. Excite a second stick of sealing-wax and bring near the suspended one. Observe closely.

Experiment 13. Try experiment 12, using two chimneys.

Experiment 14. Try experiment 12, using two rubber rulers.

Experiment 15. Try experiment 12, using one stick of wax and one chimney. Closely observe.

Observations upon the last twelve experiments: In experiment 4, was your face attracted towards the tube? Why could we not tell? What did the experimenter feel? Have you ever stroked a cat? Did you feel anything similar? If dark, did you see anything? What is that called? Children probably know *electricity*, so teacher says, "This attraction, which we have been studying today, is a sort of electricity. How did we produce it? (By friction.) It is therefore called *frictional electricity*, but since it has been discovered that it can be produced by several other means as well, it has been given the name *static electricity*."

Experiments 5 and 6 showed very plainly that electricity had been generated in the ruler and the ribbon. How many of you have ever heard a crackling when undressing? This is especially noticeable when woolen leggings are pulled off, Why? Or when woolen skirts are next to linen or silk skirts. Observe. If dark, can the cause of the crackling be seen? (Yes, tiny sparks are often visible.)

Experiment to try at home: Rub your feet, encased in stockings only, on the carpet, for several seconds. Shuffle across the floor and touch the gas jet which some one has opened for you. (Some persons can thus ignite the gas.)

How many of you find the faucet of the wash-stand "shocking"

you upon a frosty morning? Look everywhere for cases of static electricity.

Let us try to find out why the feather and pith-balls are repelled after having once touched the excited body. (Experiments 7 and 8.) I must first tell you that when these small bodies *touch* the electrified body, they, too, become electrified. When electrified, what occurred?

What differences in action were shown by experiments 9—15? Study these carefully and we see that there are two kinds of static electricity and that the like sorts repel each other, whereas the unlike sorts attract.

You will be interested to know that *Franklin* named the sort of electricity which the lamp-chimney shows when rubbed with silk, *positive* electricity, and the sort exhibited by the sealing-wax, amber, etc., *negative* electricity.

From our experiments, can you tell what sort of electricity was exhibited by each substance? (Experiment 15 made with many objects.)

ASSOCIATION AND COMPARISON:

1. Compare magnetism and static electricity.
   (*a.*) Likenesses.
   (1) Both are forms of attraction. (2) Both attract masses, hence are forms of *molar* attraction. (3) Each has two sorts of attraction. (4) In each, like sorts of attraction repel each other and unlike sorts attract.
   (*b.*) Differences.
   (1) Static electricity is only temporary, whereas magnetism is permanent. (2) Bodies frictionally electrified attract only the lightest of bodies (like pith), whereas magnets attract one of the heaviest (iron).

GENERALIZATIONS:

1. Static, or frictional, electricity is a form of molar attraction.
2. There are two sorts, positive and negative.
3. Franklin named the electricity exhibited by glass, when rubbed with silk, *positive* electricity. That exhibited by sealing-wax was called *negative*. We still use his names.

4. Two positively electrified substances or two negatively electrified substances repel each other. One positively, and one negatively electrified substance attract each other.

5. (This the teacher must tell.) Static electricity is not so valuable to man as is magnetism. Its greatest use is made by scientists in their laboratories. (Teacher may go further and explain how an electrical machine is made, and how Leyden jars are thereby "charged.")

APPLICATION:

As with the lesson preceding, the teacher may use these facts for a written lesson, either in the form of a "composition", or as a test, the questions being propounded by the teacher. Of course the final application will be made when we reach our conclusions at the end of the series of lessons.

(To be Continued.)

THE HEART OF OUR NORTHWESTERN EMPIRE

BY WILLIAM F. PHELPS, FORMERLY PRESIDENT OF THE STATE NORMAL SCHOOL AT WINONA, MINN.

Introductory.—The word Empire in the title of this article is not used in its political sense. It is rather employed to designate a vast extent of country exceptionally rich in natural resources, and not restricted by territorial lines. It embraces all of that extensive region whose commerce is tributary to the head of Lake Superior, whose western terminus is in the state of Minnesota, and whose chief central point is the city of Duluth.

The word Heart is used as best indicating the place where those traffic and other industrial movements that concentrate in and radiate from the point where the long lines of land and water transportation converge and the reciprocal exchanges of products and commodities between distant regions are finally effected. Specifically, the states of Minnesota, the two Dakotas, Montana, Idaho, Washington, and Oregon with some portions of Manitoba and the Canadian Northwest may be assumed as the area more directly interested in the commerce of the Great Lakes. The rapid and immense impetus given to oriental commerce by recent events

CITY OF DULUTH, MINNESOTA.

via the Pacific it must be confessed will powerfully affect the growth of Duluth and the development of the Northwest as a center of exchange in the immediate future.

Influence of Physical Features and Conditions.—That the character and history of a people are profoundly influenced if not largely determined by the physical features and conditions of its surroundings is a fact as conclusively established as the law of gravitation or the wheeling of the planetary worlds around their central sun.

For examples of rugged, stalwart manhood, we look not to the low, monotonous plains of the enervating tropics, where life is but a dream, or an ignoble pursuit of luxury and ease, but rather to the hills and the higher altitudes and latitudes in those zones of temperature where every breath is an inspiration and every apparently insurmountable obstacle is a virtual challenge to greater effort and indeed to the spirit of all conquering industry and enterprise. It has been aptly affirmed that "when the skies do change, men change also". Grand scenery, dancing and leaping waters, and a bracing atmosphere produce men of a different mould from those who dwell amid the mists and fogs of the lowland plains, where a dead level prevails, where the streams are turbid and sluggish, and the atmosphere is loaded with malarial poison.

Physical Outlines.—Not only do differences of elevation and atmospheric conditions, however, thus influence life, character and history, but the inhabitants of a country whose boundary lines are circumscribed within narrow limits, whose horizon is coterminous with the "visual angle that girts them round", or whose borders are unbroken by indentations of the land into the adjacent waters, or by the waterways into the land, or whose area is untraversed by noble streams forming grand arteries of communication and commercial intercourse,—such inhabitants are not likely to become a great people. Such conditions are not favorable to the production of statesmen of the broadest type or men of the most comprehensive grasp of thought,

> "Whose hands the rods of empire might have swayed
> Or waked to ecstasy the living lyre."

Influence of Environment upon Character.—Proofs of the potency of these natural forces in shaping the character and destinies of men and nations might be almost indefinitely multiplied but are scarcely necessary here. One or two illustrations will suffice for our purpose. The author of the *"Early History of Minnesota"*

very appropriately observes in his introductory that "We associate heroes like Tell and Bruce with the mountains of Switzerland and the Highlands of Scotland and not with regions of country where the outline is unbroken and the horizon appears as a continuation of the earth's surface".

The truth of the foregoing observations is amply verified in the structure, climatic conditions and history of our great republic. The territory of the United States as a whole, and largely in its several subdivisions, furnishes the requisites as to topography, temperature, climate, physical structure and the like, suited to the development of the highest degree of civilization and material prosperity. There is every variety in what the geographers term the forms of contour and relief, every kind of soil, every diversity of mineral, vegetable and animal productions suited to human needs and to the development of the powers of body and mind in the individual, and consequently to the increase of the national power and prestige among the great nations of the earth.

Local Influences.—Nor are local conditions and circumstances any the less beneficent and favorable for the growth of states and of communities of less extent and magnitude. Each has its special structure and other physical conditions as a state, with its corresponding industrial functions. There are many stars in the constellation of the republic and yet "one star differeth from another star in glory". There are single counties whose rock ribbed hills alone are stored with resources sufficient to enrich an empire. There are others whose toiling husbandmen send annually to the world's markets bread, or its equivalent, enough to feed a starving million. Still others there are whose raw materials in wood and stone if utilized, would build homes for a million more. There are single counties whose area is greater than some states. Saint Louis county in Minnesota embraces more than seven thousand square miles and is nearly as large as Massachusetts. There are states greater in extent than the home domain of some continental kingdom. There are single water powers which when developed and converted into that mysterious magic which we call electricity, will do the work of two hundred thousand horses and turn the spindles of half of the continent. There are cities still in their infancy that occupy strategic points upon the great highway of commerce whose foundations are as firm as the rocks of the everlasting hills, and whose commercial and economic advantages can

never be wrested from them. Thru the operation of the immutable laws of nature and the inevitable trend of commercial events they will compel a degree of expansion and growth that must place them in the forefront of the world's commercial marts.

Influence upon History.—A region of the superlative natural advantages such as have been indicated, affords both the opportu-

HIGH SCHOOL BUILDING, DULUTH, MINN.

nities and incentives for individual and collective enterprise and development. Industry, economy, zeal and prudence beget wealth and prosperity. Wealth begets the desire and the means of intellectual and social advancement. Hence it is not difficult to discover the relations between the physical features and characteristics of a land and the history of its people, between grand scenery,

dancing waters, sunny skies and a bracing atmosphere on the one hand and the record which the stalwart men and noble women under the stimulus of such surroundings write on the historic page for the instruction and guidance of the generations that follow them. Such an environment is well calculated to breed a noble race from whom shall spring statesmen, scholars, heroes, poets and leaders worthy of a freedom loving people. Washington, carving a pathway across the forests, streams and mountains of his native Virginia, was a type of the leadership which springs from such inspiring surroundings. Lincoln, born among the verdant hills of his "old Kentucky home", reared among the wild woods of the Wabash and the Sangamon, schooled upon the flat-boats of the Father of Waters, and disciplined by the hardships and trials of a campaign against a savage foe, illustrates the strength of natural forces in shaping the lives and forming the characters of the great leaders of the race. Our history as a nation is full of such examples and its readers will readily recall the honored names of a multitude of the noble men who by their wisdom in the councils of peace and their heroism amid the deadly perils of grim visaged war have become forever enshrined in the hearts of their grateful countrymen.

George Dewey from his humble childhood home in the Green Mountain state and his persistent wrestling with the mighty waves of the storm tossed ocean in his leviathan ships, by a single deed of unparalleled heroism changed the map of the oriental world and wrote an imperishable chapter in the history of his glorified country.

MINNESOTA

Boundaries of Minnesota.—One of the most highly favored sections of our country in the possession of these transcendent advantages of physical structure, climate and location is the state of Minnesota. From its gently sloping plains descend the streams that feed the mighty Mississippi discharging its waters into the Gulf of Mexico, the picturesque St. Lawrence pouring its volume into the Atlantic on the east, and the winding Red River of the North emptying into Hudson bay in the far north. The North Star state extends from forty-three degrees thirty minutes to forty-nine degrees north, thus covering five degrees and thirty minutes of latitude. Geographically defined, its boundaries are the British possessions on the

north, Lake Superior and the state of Wisconsin on the east, Iowa on the south, and the two Dakotas on the west.

Geographical Center of North America.—It is substantially at the geographical center of the North American continent. It is nearly equidistant from the Atlantic and Pacific oceans and from Hudson bay and the Gulf of Mexico. Within its borders are the sources of three remarkable fresh water systems leading to the north, east and south. At the head of the great chain of lakes lies Lake Superior, the largest in the world, having its beginning in the state of Minnesota. The total area of this noble commonwealth is given at 83,333 square miles. Its highest elevations as recorded in the "*Dictionary of Altitudes*" published by the United States Geological Survey and in the State Geological Survey are 2044 feet at Brule mountain and 2400 feet at the summit of the Mesaba range and Misquah hills respectively. Its lower altitudes which have been scientifically determined are in many different localities 602 and from that up to seven hundred feet more or less. More recent explorations have shown higher elevations in some localities. One hundred and seventeen stations range between six hundred and seven hundred feet, while nine hundred places are from the latter altitude up to more than eighteen hundred feet above the level of the sea. Duluth, contrary to quite a general impression is in the lower register, the lake level being given as 602 feet and the lowest land surfaces being at the same figure. The measurements at St. Paul, beginning with the surface of the Mississippi river and embracing the land levels at something like twenty different points, vary from 703 at the Union depot to 850 feet at the Como avenue bridge. The average difference in elevation above the sea between Lake Superior and the Mississippi river at St. Paul may therefore be placed at one hundred feet. Hence it follows that the Duluth citizen who journeys to the state capital goes up to St. Paul and returning comes down to Duluth. The average elevation of the Minnesota plateau is shown by the "*Dictionary of Altitudes*" to be several hundred feet higher than that of the neighboring states of North Dakota and Wisconsin.

Temperature and Climate.—The climate of this favored land is, of course, greatly influenced by the facts of its physical structure and elevation as well as by its northerly latitude or geographical position. It is claimed by geographers that a difference in altitude of three hundred feet makes a difference in average temperature

of one degree Fahrenheit. Its comparatively cool and dry climate is thus readily accounted for. But many erroneous impressions have heretofore prevailed and still do prevail in some quarters, especially in the eastern part of our country, touching the severity of the climate of Minnesota, and a brief consideration of that subject here may not be out of place.

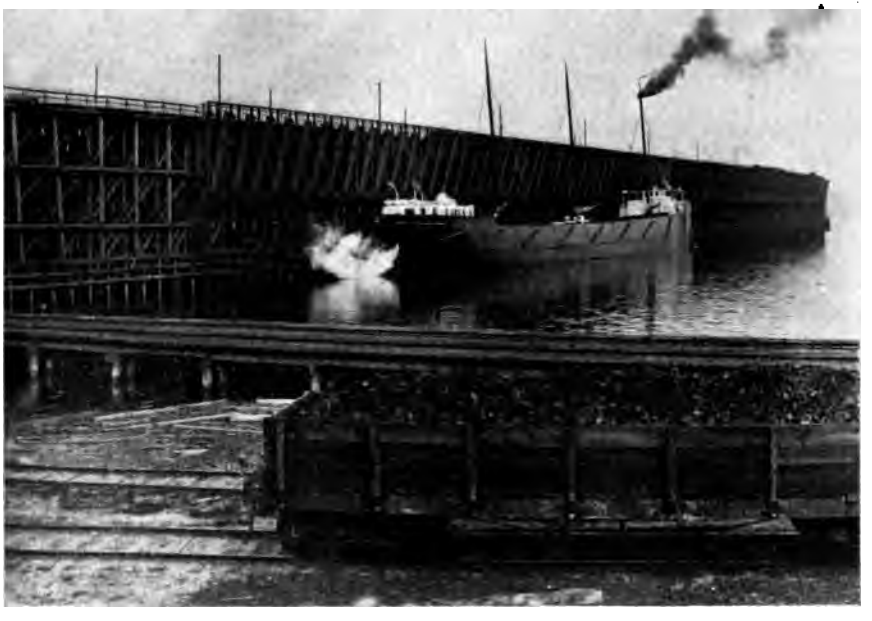
During the summer the temperature here corresponds very nearly with that of Philadelphia. While the thermometer has a high range during the day, the evenings are generally cool and refreshing. Nights, so frequent on the Atlantic coast, when the body swelters with perspiration and the individual rises exhausted rather than refreshed by sleep are here unknown. Nor are the winters any more trying to the constitution than the summers. The air is dry and bracing and the skies by day are quite generally cloudless while at night they are studded with stars. Appropriate in this connection is the tribute paid to our climate by the distinguished author of the work entitled "*Physical Geography of the Sea*," Lieut. M. F. Maury, who remarked:

"At the small hours of the night, at dewy eve and early morn, I have looked out with wonder, love and admiration upon the steel blue sky of Minnesota, set with diamonds and sparkling with brilliants of purest ray. The stillness of your small hours is sublime. I feel constrained as I gaze and admire, to hold my breath lest the eloquent silence of the night should be broken by the reverberations of the sound from the seemingly solid but airy vault above."

Herschel, the famous astronomer, once said that "In Europe the star gazer might consider himself highly favored if by patiently watching the skies for one year, he shall during that period find all told, one hundred hours suitable for satisfactory observations. A telescope mounted here in this atmosphere under the skies of Minnesota would have its powers increased many times over what they would be under the canopy of heavens less lovely and brilliant."

Official Testimony.—These statements are abundantly corroborated by official tables compiled from the "*United States Army Meteorological Register*" and by "*Blodget's Climatology of the United States*," both of which are standard authorities, based upon the system of observations conducted by the surgeons of the army and others thru a series of more than thirty years. Without going into details here it may be stated that these observations

prove beyond question that the mean spring temperature of Fort Snelling or St. Paul, which is 45.36° is identical with that of fourteen other stations where official records have been kept in the states of Massachusetts, New York, Michigan, Illinois and Wisconsin. The mean summer temperature at St. Paul for more than thirty-five years is the same substantially in the states enumerated above with New Jersey, Pennsylvania, Ohio and Long Island added to the list. The mean autumn temperature, 45.54°, was also the



DOCKS AT DULUTH, MINNESOTA.

same at St. Paul and fourteen other stations in Maine, Vermont, Canada, New York, Pennsylvania and Wisconsin, and finally the mean winter temperature of 16.6° was the same at the capital of Minnesota as at Hanover, New Hampshire; Houlton, Maine; Williamstown, Massachusetts; Montreal, Canada; and Sault Ste. Marie, Michigan.

Lines of Equal Temperature.—Any reliable weather chart of the

United States will show that the isotherms, or lines of equal mean temperature, passing thru the places indicated in the foregoing statement coincide not only for the seasons mentioned but for the year, and that while the winter temperature at St. Paul does not fall below the average of places on its own parallel of latitude, its spring temperature coincides with that of Central Wisconsin, Northern Illinois, Southern Michigan, Central New York and Massachusetts; its summer, with that of Central Wisconsin, Northern Illinois, Northern Ohio, Central and Southern Pennsylvania and New Jersey; its autumn with that of Central Wisconsin, Northern New York, a part of Northern Pennsylvania, Northern Vermont and Northern Maine, while its entire year is identical with that of Central Wisconsin, Central New York, Southern New Hampshire and Southern Maine. Viewing this subject with reference to the extremes of latitude touched by these isothermal lines we discover that St. Paul has a temperature in spring equal to Chicago which is two and a half degrees of latitude south; in autumn equal to Northern New York one and a half degrees south, and during the whole year equal to Central New York two degrees south. It is but just to say here that these facts and figures do not admit of the slightest doubt or question, no matter how widely they may differ from preconceived notions; for they are founded upon facts of observation and experience which have occupied more than an entire generation for their development and verification. It may be further affirmed that this condition of temperature not only prevails in Minnesota, but it is well established that there extends hundreds of miles to the northwest of the state an immense area of fertile arable soil possessed of a climate scarcely inferior in warmth to her own. The closing chapter of "*Blodget's Climatology*" already quoted, is an excellent treatise on the climate and resources of this vast region.

Moisture, Rainfall.—The prevalence of a pure and dry atmosphere has long been the boast of the people of Minnesota. But it should not be inferred on this account that there is any lack of moisture or rainfall or that long and severe droughts are characteristic of this country. On the contrary, common experience, official records continued thru long periods in the past, and the reports of the Weather Service now fully organized and extended to the remotest parts of the country, all combine to show that there is not now and never has been since its settlement any abnormal defi-

ciency of moisture. The precipitation in summer and winter affords a full supply of water for the streams and for the growth and maturity of the most bountiful crops. Indeed so prolific is the soil and so plentiful the precipitation that Minnesota has become one of the foremost grain producing states both in the quantity and quality of the leading cereals and especially of wheat exported to the world's markets to supply the deficiencies of the lands beyond the sea. The volume of other grains, corn, oats, rye, barley, and flax seed, is shown by the enormous receipts and shipments from her great lake-port, Duluth. The snow-fall is less than in states to the south lying adjacent. Statistics for many years establish the fact that the average precipitation here does not exceed 27 inches and it falls considerably below that of Wisconsin, Illinois, Michigan or New York, and very far below that in the eastern states generally.

Blizzards and Cyclones.—In years past, much has been said in the eastern press of the fierce winds, blizzards and tornadoes of this northwestern region, altho the comparatively recent experiences in several of the older states, notably of New York, in severe meteorological disturbances have tended to materially modify these adverse criticisms. As a matter of fact the mean force of the winds, according to observations for ten years made at eleven different military posts in nine different states both east and west, have shown that for this whole period the sweep of the winds at Fort Snelling has been less than at any one of the stations, and twenty-five per cent. less than the average of all the stations for the entire term. Moreover, it has been proved that the mean force in any one year is below the average at all stations with one exception in which it slightly exceeded the average.

Lakes and Rivers.—"Like the Garden of Eden", says Mr. Neill in his history of Minnesota, "the state is enriched by rivers and lakes. There is water, water everywhere; and in view of this characteristic, Nicollet called the country Undine. To Naiads and all water spirits it would be a perfect paradise. The surface of the country is dotted with lakes and in some regions it is impossible to travel five miles without meeting a beautiful expanse of water. Many of these lakes are linked together by small clear rivulets while others are isolated and alone. Their configuration is varied and picturesque. Some are large with precipitous shore lines and contain wooded islands. Others are approached by gentle, grassy

slopes. Their bottoms are paved with agates, carnelians and other beautiful water worn pebbles." Owens in his report upon the Geology of Minnesota, Iowa, and Wisconsin remarks of these lakes that, "Their beds are generally pebbly or covered with small boulders which peep out along the shore and frequently show a line of rocks around the entire circumference. Very few of them have mud bottoms. The water is generally sweet, clear and wholesome, and north of the water shed is as cool and refreshing during the

A TYPICAL LAKE IN THE PARK REGION, MINNESOTA.

heat of the summer as the water of springs and wells. All the lakes abound with various species of fish of a quality and flavor greatly superior to those of the streams of the middle and western states."

Water Falls—Water Powers.—This wonderful country also abounds in charming water falls. The state of New York shares with Great Britain the sublimest cataract in the known world, and

Minnesota has a joint ownership with the same people in a picturesque waterfall. This is in Pigeon river about a mile and a half above the mouth where it discharges into Lake Superior. The perpendicular descent is about sixty feet after which the river chafes its way for several yards. About one mile below the west end of Grand Portage, the old depot of the Northwest Company, are the great cascades of Pigeon river. The scenery here presents the singular combination of wild grandeur and picturesque beauty, with one of the most dreary and desolate aspects imaginable. In a distance of four hundred yards the river falls 144 feet. The descent is in a series of cascades thru a narrow gorge with perpendicular walls, varying from 40 to 120 feet on both sides of the cañon. The streams of Cook county nearly all go into Lake Superior with a leap and a bound. Half a mile from the lake the Kawenbash rushes thru perpendicular walls of rock seventy-five feet in height and at last pitches down an altitude of eighteen or twenty feet.

St. Croix Falls.—One of the most beautiful of the numerous cataracts of Minnesota is the St. Croix, about thirty miles above the city of Stillwater. Here the river rushes between high walls of trap rock, at first with great velocity, forming a succession of whirlpools until it makes a sudden curve, then glides along placidly reflecting in its deep waters the dark images of the columnar masses as they rise towering above each other in solemn grandeur to the height of 100 to 175 feet. In Kettle river, a tributary of the St. Croix, there are also rapids and falls of great interest. The Vermillion river, a western tributary of the Mississippi, furnishes yet another example of a charming waterfall. This little gem is located about a mile from the city of Hastings, in Dakota county.

Minnehaha.—The falls of Minnehaha are formed from the small stream that is the outlet of Lakes Harriet and Calhoun, near Minneapolis, gently gliding over the precipice into an amphitheatre and has but little of the cataract's thunder. The descent is about sixty feet, shaped like a parabolic curve which drops without any deviation or interruption until it has reached its lower level when the stream goes on its way as if rejoicing and curling along in laughing, childish glee at the graceful feat it has performed in bounding over the crest of the rock formation it has left behind.

Minnehaha has been rendered famous in Longfellow's immortal verse which is familiar to every lover of poetic literature. The poet in his vocabulary speaks of Minne-ha-ha Laughing Water, a

MINNEHAHA FALLS, MINNESOTA.

waterfall or a stream running into the Mississippi between Fort Snelling and the Falls of St. Anthony. "All waterfalls," says Mr. Neill, "in the Dakota tongue are called 'Ha-ha' but never Minnehaha." "The letter 'h'," he continues, "has a strong, guttural sound and the word is applied because of the curling or laughing of the waters. The verb 'I-ha' means to curl the mouth or to laugh because of the curling motion of the mouth in laughter. The noise of 'Ha-ha' is called by the Dakotas 'I-ha' because of its resemblance to laughter."

The subjoined beautiful quotation seems not inappropriate at this point.

"Stars in the silent night
Might be enchained,
Birds in their passing flight
Be long detained,
And by this scene entrancing
Angels might roam,
Or make their home,
Hearing in waters dancing,
Mid spray and foam,
Minnehaha!"

Falls of Saint Anthony.—The falls of St. Anthony are in the Mississippi river separating the two sections of the city of Minneapolis and need no description here. This fall was named by Hennepin, a Franciscan of the Recollect order. He saw it while returning from Mille Lac in the month of July, 1680, and named it after his patron St. Anthony of Padua. In the last edition of his book of travels the adventurous Father says, "The navigation is interrupted by a fall which I called St. Anthony of Padua in gratitude for the favors done me by the Almighty thru the intervention of that great Saint whom we had chosen patron and protector of all our enterprises." "This fall," he continues, "is forty or fifty feet high dividing in the middle by a rocky island of pyramidal form." He related that as he was passing the falls with a party of buffalo hunters he perceived a Dakota up in an oak opposite the great fall weeping bitterly, with a well dressed beaver robe, whitened inside, and trimmed with porcupine quills, which he was offering as a sacrifice to the falls, which is in itself admirable and frightful. "I heard him while shedding copious tears, say, as he spoke to the great cataract, 'Thou who art a spirit, grant that our nation may pass here quietly without accident, may kill buffalo in

abundance, conquer our enemies and bring in slaves, some of whom we will put to death before thee; the Messenecqz (Fox Indians) have killed our kindred, grant that we may avenge them.'"

St. Louis River Rapids.—Probably the most imposing and one of the most important of the numerous water courses of the state of Minnesota is the St. Louis river, which pours its aqueous tribute into Lake Superior thru what is known as the natural entry, between Minnesota and Wisconsin points. This river takes its rise in the eastern central portion of St. Louis county, between the Mesaba and Vermillion ranges, being supplied with water from swamps and from many of the almost innumerable lakes of which there are not less than two hundred in the county and which so greatly abound in the region north of Lake Superior. The St. Louis has an aggregate length according to that eminent engineer and explorer, Mr. A. E. Lohman, of about two hundred miles; and he estimates its entire watershed basin from which its supplies are drawn at not less than four thousand square miles. The river is very tortuous, flowing thru forests and marshes almost interminable. Its general course from its upper sources of supply is westerly, thence south, thence southwesterly, thence southerly and southeasterly, and finally as it rushes down from the upper plateau to the lake level, a height of about five hundred or six hundred feet, it turns quite sharply to the east, and finds its way thru the bays of St. Louis and Superior to the great lake at the southern extremity of Minnesota Point. From Cloquet to Thompson the current is very swift. From the latter point it rushes, frets, turns and tumbles to the lower level at Fond du Lac in a series of rapids and cascades, that are almost bewildering and bewitching to behold. Its course thru these two points has been cut and torn thru slate and hard trap rock. As a natural object of wild and rugged beauty the rapids have no parallel of this kind in the Northwest or elsewhere.

The chief interest in these rapids, however, centers in their surpassing value as a source of power for the development and distribution of the electric current. It has been estimated by competent authorities that by utilizing the great watershed of this and an adjacent river running in an opposite direction, by means of a short canal and by dams at proper points not less than two hundred thousand horse power may be made available for use at the head of the lakes and other points for domestic, manufacturing and such other purposes as are now required of this subtile agent.

It is only a question of time and that a short period, when these all important economic objects will be attained and an industrial as well as commercial center will be developed second in importance to no other in the Northwest, if indeed in the whole country. Taken in connection with the inexhaustible supplies of such raw materials as lumber, iron ore, slate, grain and produce of all kinds, together with the unsurpassed facilities for cheap transportation to the markets of the world, the necessity for the development and use of this water-power is not only apparent but self evident and cannot much longer be postponed.

EDITORIAL

The New Geography

It is to be feared that there still are some teachers who believe that memory is the only power of the mind that may be cultivated by the study of geography. Following the lead of books published fifteen or twenty years ago, they assert that the acquisition of facts is the only or main purpose of the study. This assertion is an unfortunate one, as it shows a lack of acquaintance with the best thought of recent years upon the subject; it also shows how difficult it is to break away from the past and to live in the present. And yet this is what must be done in geography. The past looks upon it as a knowledge study having little or no disciplinary value; the present, while not ignoring the knowledge value, declares that it is second only to arithmetic as an instrument of mental discipline.

It is well to bear in mind that there is a new geography which is as different from the old "sailor geography" as it well can be. The old concerned itself with the gathering and holding of facts, many of which were of but little value; the new acknowledges the value of facts, that is, of some facts, but is mainly solicitous about the unfolding of mental faculty. The old was unconscious of any law or order in its learning of facts; the new reveals a logical sequence of topics which cannot be ignored without loss. As teachers we should concern ourselves with this new geography. "Let the dead past bury its dead." Were those who in the past wrote disparagingly about geography to write now, many of them

would not confine its disciplinary value to memory, but would cheerfully admit that it also cultivates the perceptive powers, the imagination, and the judgment. As honest men, they could not well do otherwise. McC.

Applied Geography

One of the weakest points in the teaching of geography is the failure to apply the knowledge derived from a study of the subject to the social conditions of our present-day life.

It is very common to see a great number of facts developed during a recitation without any effort whatever being made to show the relation of these facts to life—plant, animal and human. This is feeding the pupils on the dry husks of the subject when they are longing for the kernel which lies within. This improper method of treatment is, I believe, chiefly the result of two causes. In the first place we try to cover entirely too much ground in the length of time at our disposal. It is felt that just so much information must find its way into the minds of the children without regard to their being able to make any use of such information. In the second place comparatively few teachers have been trained to apply geographic knowledge to human affairs.

There is such a multitude of facts in geography which can be thus applied, that we should be careful in selecting material to omit those portions which have not in them the element of human interest, or at best to give them but an incidental treatment. Wherever possible, and in the majority of cases it is possible, make the application strictly local at first. This invests the study with an interest and a value which can come to it in no other way. Afterwards apply the facts as broadly as possible. Our government is doing some very valuable work along the line of applied geography. During recent years great areas in the West have been set aside as forest reserves. In the arid regions where every drop of water is so badly needed this is of particular importance. These forests conserve the water supply and greatly lessen erosion, thus conferring a double blessing upon the inhabitants. Since the water supply and the waste of the land thru erosion, have to do directly or indirectly with every individual, it is a matter which should be carefully treated in our schools. It is not enough to work out the principles governing erosion. We must apply the principles in our own neighborhood first and later to outside regions.

The child will readily find in his own home surroundings, flood plains and deltas which are being constructed. Here he can apply the principles of erosion and deposition, and in addition can see the relation between these processes and fertility of soil products and human movements. In studying the relation of latitude to climate the teacher too frequently stops when the facts pertaining to this relation have been brought out. Apply this by telling of the products, occupations and people of the frigid regions, the temperate areas, and the torrid belt. Good pictures are very helpful in this work.

A knowledge of the climate of Greenland, for example, is of some value, but a clear understanding of the climatic control in this region is of much more value. Here are a people who dress in skins and furs; who travel in sledges upon the ice; whose food is largely fat and oil; to whom culture and refinement are forever denied; and all of this is due to the climatic conditions which obtain here. It is of comparatively little value to know the position of the Alps, their length, width, height, and the names of the most important peaks. Apply here the influence which mountains everywhere have upon life, and see to what extent this influence will explain the differences in language, customs, laws, industries and national characteristics of the peoples on their opposite sides.

Industrial geography often falls short of what it might accomplish because the industries and products are studied apart from the surroundings of the pupil.

Suppose that rubber, as an important product of the Amazon basin, is being studied. In addition to knowing where it is produced and how, pupils should know how it enters into their daily experiences. Note the countless wheels seen upon the streets daily; the rubber garments worn during rainy weather; the door mats, erasers, rubber bands and many other things in common use the construction of which calls for this commodity.

If cattle raising and the meat industry are under consideration, bring the discussion to bear upon the daily life of the child. He should note that meat in some form is used at almost every meal. Call his attention to the boots and shoes, the harnesses, the valises, the leather used in making furniture, etc. Thru such a line of study the importance of this industry is made apparent and it becomes a reality to the pupil.

Countless illustrations might be given but I simply wish to

indicate clearly a line of work which is not carried out as fully as it should be, and which is bound to greatly improve the teaching of geography. J. F. C.

The Course of Study in Geography

To be of the highest value as a disciplinary study, and at the same time to be practical and utilitarian, a course of study in geography should have three qualities: it should serve to develop the observational and perceptive faculties; it should be rich in selected material; it should have a direct bearing on life and its activities. In other words, in the first three years that side of nature study which pertains to geographic forms and physiographic forces should constitute the main issue. In the next three years localities, peoples, customs, political divisions, and history should be emphasized; during these years the problems of environment—that is, topography and climate—should be kept in the foreground, and at this time most of the memory work may be accomplished. In the seventh and eighth years, the chief feature should be the study of the distribution of industries as affected by geographic factors. This is the *application of geography to life*, and it goes without saying that it is the most important aspect of the study.

Most courses of study are balanced in about this order, and to this extent are good. Within the past three or four years, however, there has been a disposition to finish the study in the sixth and seventh years, dropping it from the eighth.

A more unfortunate step could not be taken. That aspect of the study which treats of the application of geography to the activities of life neither can be understood nor assimilated by pupils of the sixth and seventh years; it requires a maturity of thought which they do not possess and an experience in life that years only can give. The introduction of the economic side of geography into the high school would be a far wiser move, and the Germans recognized the wisdom of such a step many years ago. J. W. R.

Suggestions to Teachers

When beautiful pictures can be bought so cheaply, there is no excuse for not illustrating every subject in geography. Of course the school authorities should provide generously these important helps. It could be easily done in many towns by using the money foolishly thrown away on worthless text-books, or wasted in unnecessary so-called

improvements, such as fire-escapes which only monkeys can use, and ventilating flues which never ventilate. How long will parents sit idly by and allow their children cheated out of their rights to the best kind of an education?

I am sorry to report from actual observation that some teachers are still following the text-book too closely in their work, assigning pages of matter to commit to memory, or of questions to look up, instead of teaching the subject topically.

How little attention is at present given to a study of the leading cities compared to their importance in business and population. The commerce of the ten largest cities in the United States, their growth, manufacturing industries, and general or striking features should be carefully noted and dwelt upon till the class feels somewhat familiar with them.

I recently had the pleasure of accompanying one of my special teachers when she took her class out for a field lesson. Fifty pupils, fifth grade, all armed with pencils and note-books filled the special car. As soon as they left the vicinity of the school the pupils began to observe buildings, streets, waterways, bridges and the topography of the land. They took notes, discussed, and asked their teacher questions all the afternoon. A busier set of boys and girls was never seen. The excursion went to an island in the harbor, and land and water forms, the neighboring islands, the coast line, and animal, plant, and human life were observed. There was no fooling, no silly actions, but these young children were as dead in earnest as if they were college boys or teachers. This was the result of systematic and continued field work for one year under an enthusiastic and skillful teacher. The power of concentration and of observational study thus developed was worth more than memorizing a whole primary geography.

The California plan of uniting both school and public library is most excellent. It is being slowly adopted in Boston. Fifty books on the geography and history work of the month together with a few good stories are put in a room, and the pupils take them out under the care and guidance of the teacher. When the subjects of study change, a new set of books is sent to the school. The books are in great demand, and recitations are improved.

One of the best ways to help a child read and comprehend a map is to help the child make a map of some familiar piece of land near the school-house.

A recent book well worth owning is entitled "*The Chinese Empire Past and Present*" by Gen. Tcheng-Ki-Tong and John H. Gray, published by Rand, McNally & Co., Chicago. The half-tones in this book are wonderfully clear, and the pictures represent scenes in which all teachers are deeply interested at the present time.

It is about as important in geography to know what *not* to do as to understand what is best to do.

The continent of Asia becomes this year more important than usual, hence more time should be given to it.

There is no time to spend in triangulating the outlines of the grand divisions or in drawing from memory when Heath's outlines or Klemm's relief maps can be purchased so cheaply.

Can your children describe their own city or town? If not, why not?

Ask the children to look up the following words: *trekking, laager, commando, khaki, yamen, dowager, boxer, mandarin, legation, viceroy.*

Observational lessons on climate are always profitable.

Are the minds of your children being disciplined as they study geography? K.

The Lower Susquehanna

The lower course of the Susquehanna river contains some of the most varied scenery in the eastern United States. Above Harrisburg, the capital of Pennsylvania, is a series of beautiful water gaps, cut thru Pocono grey sandstone and Catskill red sandstone and shale. Twenty-five miles below Harrisburg, from Columbia to Chesapeake bay, the river is dotted with tens of thousands of beautiful islands, one of which rises almost perpendicularly to the height of several hundred feet and is capped with a growth of fine trees.

The lower Susquehanna traverses hard crystalline schists whose strike is oblique to the course of the stream. This causes the main river channel to migrate slowly toward the east bank and in many places this channel is more than one hundred feet in depth while the rest of the river is shallow.

The river is especially remarkable for its pot-holes, which exist in great numbers and in almost every condition of position and inclination. Some of the pot-holes are twenty feet in depth and ten feet in diameter. One of the most remarkable of these

striking examples of corrasion may be seen near McCall's Ferry. This one, fifteen feet in depth and four feet in diameter, has been drilled by the water entirely thru a shelf of rock which is now twenty feet above the present high water level of the river and one-fourth of a mile away from its present channel. And one must remember in considering this river that its rock bed is extremely hard crystalline schist, that it is hemmed in between hills several hundred feet in height, and that consequently there are no flood lands and no meanders.

Teachers in Pennsylvania sometimes say to me that they have no opportunity to study river corrasion at first hand and that consequently their teaching of rivers is crude and unsatisfactory. They seem to think it necessary to see the great rivers and cañons of the Rockies to appreciate the relation of streams to their environment. But from the little that has been said about the lower Susquehanna it should be evident that great erosion effects are not confined to one region and that a microcosmic world lies in every school district and beneath the eye of every teacher. H. J. R.

Divides

In presenting to a class in geography an early lesson on land forms it is a common practice to exaggerate the sharpness of a divide by comparison with some artificial object, generally the roof of a house, or by the selection of some sharp ridge whose profile can perhaps be seen on the horizon. This is in a measure necessitated by the fact that younger students more readily grasp the essential form of a small and sharp subdivide, the whole of which can be seen from one point of view, than the conception of a watershed of greater magnitude and less perceptible gradient. Again, while the axis of the valley, or line of minimum altitude, being marked by the river or brook which occupies it, is thus determined for the pupil, the divide, or line of maximum altitude has no such convenient "land mark" to designate it and has to be located by the pupil.

Accordingly the representation of all divides as sharp ones and the exaggeration of the distinctness of these is natural, and possibly justifiable, in indoor teaching. But as classes advance this idea must be corrected both by outdoor observations and by careful descriptions of important watersheds. An excellent example for this purpose is found in the September number of the "Ameri-

can Geologist" in an admirable article by Dr. Alexander N. Winchell on the Gabbroid Rocks of northern Minnesota. In the course of the introduction (page 154) Dr. Winchell says: "This area occupies the northeastern part of the state of Minnesota, and the adjacent portions of Canada, lying to the north and west of Lake Superior. Within this small area are found the watersheds separating the head waters of three great river systems: to the north the Red River and Rainy River whose waters uniting in Lake Winnipeg are carried to Hudson Bay thru the Nelson; to the east the St. Lawrence system draining the five great lakes; to the south the Mississippi, finally reaching the waters of the Gulf of Mexico. The head waters of these river systems, instead of being in a high and mountainous district, occupy an area remarkably low, and not a single mountain exists in the district. The highest altitude anywhere in Minnesota is less than twenty-three hundred feet above sea-level, while the average elevation of the watersheds is undoubtedly less than two thousand feet." J. A. D.

REVIEWS

Dr. Hermann Berghaus' Chart of the World.—Twelfth Edition, 1897. Revised by H. Habenicht and B. Dommann. Price from $5.00 to $6.00, according to mounting. Justus Perthes, Publisher, Gotha.

Kaufmännische Wandkarte der Erde (Commercial Wall Map of the World).—By Paul Langhans. 1900. Price, mounted, $3.00. Justus Perthes, Publisher, Gotha.

Among makers and publishers of maps in Europe, none are better known than the firm of Justus Perthes (whose pocket Atlas was recently favorably reviewed in these columns). Some of the most famous cartographers and geographers have worked for this publishing house, and names such as Stuelpnagel, Berghaus, Petermann, Stieler, Sydow, and more recently of Habenicht, Vogel, Wagner, Lueddecke and Langhans are too familiar to students of geography to need further mention. From this house came to us the well-known large Stieler Atlas, and the equally good small pocket atlasses (five in number) which are designated by Mr. Hugh Robert Mills in his recent *International Geography* as "the most perfect pocket atlas known."

The firm of Justus Perthes has recently published two large charts of the World, one of which appeared about two years ago in an improved edition under the title *Dr. Berghaus' Chart of the World*, revised and brought up to date by H. Habenicht and B. Dommann. The second map, published this year, is compiled by the well known geographer, Dr. Paul Langhans, the author of a very useful *Commercial Atlas of the World*.

The Berghaus Chart gives a comprehensive exhibit of the chief regular com-

mercial routes traversed by ocean steamers and sailing vessels of all nations, also the principal overland railroad lines, the telegraph and ocean cable systems, etc. In order to be of universal service in all countries of the globe, the map was edited in the English language. It forms a handy and indispensable companion in the office of merchants, railroad men, maritime offices, civil engineers' offices, but is likewise adapted for libraries, colleges, and schools, as well as on board of vessels of the merchant marine and navy.

The chart is drawn on Mercator's projection, and owing to this fact, the countries in the higher latitudes are shown on a greatly increased scale, and with a great fullness of detail.

The study of geography may be pursued either with the assistance of a terrestrial globe, or by using reference maps or atlasses. Large wall maps are, in many respects, superior to large atlasses, because one is enabled to find everything on one map, without being compelled to turn over the pages of sometimes cumbersome books. Of maps suitable for applied or commercial geography those based on Mercator's projection are, for many reasons, the handlest. While they do not represent the areas on a uniform scale, those between 60 degrees latitude and the poles becoming very much exaggerated, the proportion between width and length is everywhere correctly maintained. As is well known, the areas increase in charts on Mercator's projection in proportion to the square of the secant of the latitude (x) or as $1 \div \cos^2 x$, i. e., degrees of latitude are increased on the map in the same ratio or proportion as the degrees of longitude diminish on the sphere. Hence the Mercator projection shows countries and oceans truthfully as to form, while the scale varies in different parts of the map. Such charts are particularly adapted for purposes of navigation, for owing to the fact that the meridians and parallels of latitude are drawn in straight lines, the course of a ship between two points can also be drawn as a straight line.

The Berghaus chart is beautifully engraved, and shows the chief topographical features of the land, besides being full of information regarding the oceans. On the land the map shows rivers, canals, cataracts, rapids, swamps, docks, coaling stations, treaty ports, altitudes in meters above sea-level, etc. The different colonial possessions—British, German, French, Portuguese, Italian, Dutch, Danish, and Spanish—are shown in colors. On the water, the map shows the routes actually used by the principal steamship and sailing vessels, which are numbered and arranged in a list by continents and nationalities. It gives the tracks of outward and homeward bound steamers, including the distance in nautical miles and the time required for the voyage; the summer and winter routes of sailing vessels, the warm and cold ocean currents with their mean velocities; the limit of pack ice, the average and extreme limit of drift ice or of ice bergs; the reefs, sandbanks and shoals, dangerous to navigation; the occurrences of seaweed; the date boundary line in the Pacific ocean; the two hundred meter (approximately one hundred fathom) line of soundings, and much other useful information.

A smaller inset map furnishes a good representation of the countries and seas around the poles, drawn on Lambert's polar projection; another smaller map shows the principal telegraph and cable lines; a third one is entitled a wind chart.

The hours of high water are indicated, also the surf-bound coasts, strong tidal streams, etc. The longitude is designated east and west from Greenwich, by degrees, and also in time; and the date and length of the longest day in every month are given on the parallels. In the Berghaus Chart the American Continent is placed in the center of the map, which measures when mounted 61 by 37 inches, but which can also be had as a folded map, 8 by 10 inches in size, the price varying from twenty to twenty-four Mark, or from five to six dollars.

The other wall map, by Langhans, measures sixty-three by forty-two inches when mounted, and is somewhat cheaper, being printed instead of engraved. The price mounted being 8 Mark in four sheets, unmounted, and 12 Mark when mounted as a wall map.

In this chart, which is also drawn on Mercator's projection, the longitude of Greenwich, or the zero line, is placed in the center of the map, and on the left is shown the American Continent and a part of the Pacific Ocean, while to the right we find Asia and Australia and the western half of the Pacific Ocean, including Japan and the Philippine Islands. Tho this map has special reference to German commerce and trade, and to the new German colonies, it is equally well adapted for general geographical purposes. The Berghaus Chart is, perhaps, more replete with information, but on the other hand the Langhans chart is much more clear and comprehensive, the lettering is large and more easily read, and the author seems to have studied hard to omit all unnecessary matters, and to include all matters of chief importance. For German mercantile firms this latter map is invaluable because it gives not only the principal German steamer lines, but also all German consulates, all customhouses, and the treaty ports. In showing the principal rivers, the aim was in each case to show by special marks the limits of their navigability. This, and many other details too numerous to mention, render the map of universal use. It is indeed difficult to express a preference between the two well-executed maps, for each would seem to have its special adaptation and advantages.

WM. PAUL GERHARD.

Man and His Work.—An Introduction to Human Geography, by A. J. Herbertson, Ph. D., and F. D. Herbertson, M. A., 16 mo., 8—118 p., 1899. Adam and Charles Black, London.

A neat little book with an introduction and fifteen short chapters. The chapter headings show the logical trend and the scope of the authors' thought. They treat the frozen desert, the temperate forests, the steppes, the hot deserts, the equatorial forests, mountain, plain, and coast, influence of occupation, agriculture, rise of the fine arts, rise of manufactures, trade and transport, distribution of population, government and the races of men.

The treatment is scientific and modern. The evolution of institutions is always in mind, and the pages are loaded with concrete illustrations. In fact, the book gives one the impression constantly of being condensed.

There is really no fault to be found with the book, except, perhaps, its

brevity. It will be found very helpful to put into the hands of classes in the upper grades of our schools, particularly Normal schools. It has, what is much needing emphasis in our schools, a consistently human point of view thruout.

J. PAUL G.

The Geology and Natural Resources of Nipissing and Temiscaming.—By A. E. Barlow; 1899. 30 cents. Geological Survey of Canada, Ottawa.

Of the various reports on the district about the head waters of the Ottawa river, the most recent and at the same time by far the most complete that has ever been issued is the above. While it embraces over three hundred pages and two large maps besides many illustrations, it is to the general introduction that the teacher of geography is especially referred. This includes besides the physical geography of the region a succinct account of its fauna, flora and climate, as well as of the early explorations, and is written in a clear and masterly style.

The area embraces nearly seven thousand square miles, and is probably a fair type of the country in the Laurentian hills, north of the longer settled and hence better known regions of older Canada. Its general character is described as that of an "undulating rocky plateau with a gentle slope towards the east and southeast" and having a "general elevation varying from nine hundred to twelve hundred feet above the sea." The influence of the underlying rocks on the surface is shown in a careful and instructive manner, while the structure of the ancient valley occupied by the Ottawa river and Lake Temiscaming is considered by Dr. Barlow to be the most interesting of the physical features.

The entire report with the accompanying maps (scale 4 in. = 1 m.) is furnished by the Librarian of the Geological Survey Department, Ottawa, Ont., at the nominal price of thirty cents. J. A. D.

Descriptive Atlas of Western Canada.—Issued by direction of the Hon. Clifford Sifton, Minister of Interior, Ottawa, Canada, 1900.

In fourteen quarto pages the above pamphlet presents much matter of a highly valuable character for the teacher of Canadian geography. Besides separate maps of each province, there is a map of the Dominion which embraces the results of the latest surveys in the Yukon, MacKenzie river, Keewatin, and Arctic ocean districts. The maps are accompanied by a considerable amount of statistical matter, brought, apparently, well down to date. It is for gratuitous distribution, and can be had on application to the Honorable Minister of Interior, Ottawa, Canada. J. A. D.

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SINCE MAY 26, 1900

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PRELIMINARY REPORT OF THE COMMITTEE ON LANTERN SLIDES[1]

(Continued from page 176)

BY E. R. SHEPARD, OFFICIAL PHOTOGRAPHER, MINNEAPOLIS, MINN.

We herewith submit a list of fifty views of subjects for lantern slides, which, in connection with those previously published, constitute one hundred select subjects. The cost of preparation and production is so much greater than originally expected that it has become necessary to increase the price. After March 1st, 1901, these slides will be furnished at 40 cents each or $35.00 per hundred. Until that date we will continue to fill orders from members for the uniform price of 25 cents per slide.

Many letters are received containing inquiries for material not included in our published lists. To save considerable time in making separate replies to these letters, permit me to say that all matter for distribution to members of the Bureau will be listed in the Bulletin as soon as the material is ready to be sent out.

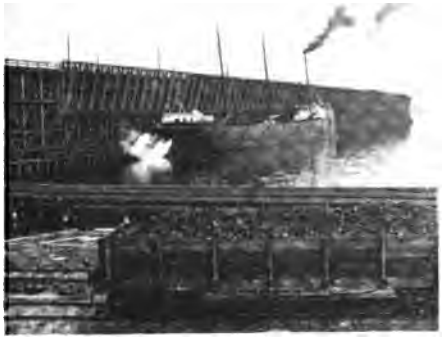
Brief descriptions herewith accompany each scene except in those cases where they are so well known that the name alone has seemed sufficient.

No. 51. "Milling District and Falls of St. Anthony, Minneapolis."—The view shows a group of the celebrated flour mills of Minneapolis, which, as a whole, constitute the greatest flour mills in the world.

No. 52. "Elevators at Duluth."—The scene is a group of the terminal elevators at the head of the Great Lakes, where the grains from the "world's great bread basket" are stored, cleaned, and made ready for shipment via the Great Lakes to the mills supplied by this territory, and also to the continent of Europe.

No. 53. "Whale-back Loaded with Grain."—This is a freight carrier of that peculiar construction called "whale-back," now so much used in lake transportation.

[1] Because of an unavoidable delay this report was not received in time to be given its usual position.—EDITOR.



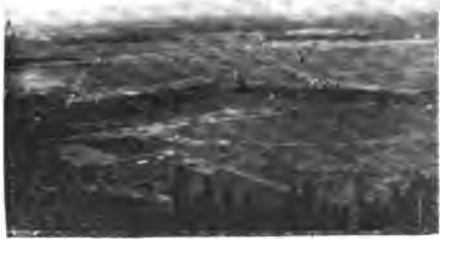
No. 55. **Iron Ore Docks at Duluth.**

No. 56. **Coal Docks at Duluth.**

No. 59. **Woodward Avenue, Detroit.**

No. 62. **Helena, Montana.**

No. 63. **Butte, Montana.**



No. 67. **Flathead Valley.**

No. 54. "Erie Canal Boat."—A view of an Erie canal boat loaded with grain.

No. 55. "Iron Ore Docks at Duluth."—View of one of the largest iron ore docks in the world, with vessels loading ore. (NOTE.—One of a series illustrative of the iron industry.)

No. 56. "Coal Docks at Duluth."—The scene is a panorama of the Pioneer Fuel Co. docks, with vessels unloading and cars loading coal for shipment to the interior. (NOTE.—One of a series illustrative of the coal industry.)

No. 57. "Blockade of Vessels at the 'Soo.'"—This is a group of vessels tied up owing to the locks being out of order, rendering it impossible for them to pass up or down, and serves well to illustrate the idea that the tonnage at this port surpasses the tonnage of any port in the world.

The following are general views of the cities named, all of which are too well known to need any comment.

No. 58. "General View of Duluth."

No. 59. "General View of Detroit."

No. 60. "General View of Minneapolis."

No. 61. "General View of St. Paul."

No. 62. "General View of Helena."

No. 63. "General View of Butte."

No. 64. "General View of Seattle from Queen Anne's Hill."

No. 65. "General View of Montreal."

No. 66. "Quebec, from Lévis."

No. 67. "General View of Flathead Valley, showing Kalispell."—The Flathead Valley, one of the most fertile in this country, is situated in Northern Montana, west of the main range of the Rockies.

No. 68. "General View of Kaslo, Kootenai, and the Selkirk Mountains."—The view is from a point overlooking the mining town of Kaslo on the upper portion of Lake Kootenai, showing the beautiful peaks of the Selkirks, which form the mountain walls of the eastern shore of the lake.

No. 69. "General View of Vancouver."

No. 70. "A View in Victoria Harbor."

No. 71. "St. John's Harbor, New Brunswick."

No. 72. "The Navy Yard in the Dalles of the Wisconsin River."—A narrow, post-glacial valley, seven miles in length, near Kilbourn City, Wis. The rounded projections of rock are due to

No. 68. **Kaslo, Kootenai, and Selkirk Mts.**

No. 70. **In Victoria Harbor.**

No. 72. **Dalles of the Wisconsin.**

No. 73. **Ink Stand. Lower Dalles.**

No. 74. **Looking up the Narrows.**

No. 75. **Jaws of the Narrows.**

the more rapid decay and removal of the sandstone along the numerous joint planes or cracks. Rain water flowing into the cañon follows these joint planes, enlarging the cracks until in time the projecting rock masses become isolated "chimneys" on the cliffs or detached islands in the river.

No. 73. "Ink Stand. Lower Dalles."—An example of an island thus formed.

No. 74. "Looking up the Narrows, Dalles of the Wisconsin."

No. 75. "Jaws of the Narrows. Romance Cliff and High Rock."

No. 76. "Standing Rock. Dalles of Wisconsin."—A striking illustration of the effect on erosion of differences in hardness of rock. The cap of harder rock has resisted weathering better than the other parts. "Vacation Days", a small pamphlet giving numerous illustrations and descriptions of the formations at the Dalles, can be secured from Mr. George S. Marsh, First Ass't Gen'l Pass'r Agent, C. M. & St. P. Ry., Chicago.

No. 77. "Castle Rock, Camp Douglas, Wis."—A remnant of a former and higher plain. The erosion cycle which produced the present broad plain in the vicinity of Camp Douglas and Necedah was not completed; and the conspicuous and romantic "castle rocks" together with the highlands towards the west clearly mark the level of the earlier plain.

No. 78. "View of the Mississippi River between Minneapolis and St. Paul."

No. 79. "Lake Pepin."—The deposit of siliceous insoluble materials brought in by the Chippewa river from the sandstone formations of Wisconsin is so great that the Mississippi is partially dammed up, causing the spreading of its waters and the formation of Lake Pepin. The lake is about twenty miles long and on an average nearly three miles wide, almost completely filling the valley between the rock bluffs.

The following six views are typical lumbering scenes taken from various lumbering points in Wisconsin, along the line of the "Soo" railroad.

No. 80. "A Logging Camp in Winter at Pembina."—The scene shows a group of log cabins in the heart of the pine forest, buried in the deep snows of winter.

No. 81. "A Towering Sled Load of Immense Pine Logs."

No. 82. Shows a logging way in the pine woods.

No. 76. **Standing Rock, Dalles of Wisconsin.**

No. 77. **Castle Rock, Camp Douglas, Wis.**

No. 78. **Upper Mississippi River.**

No. 79. **Lake Pepin.**

No. 97. **Cutting Corn with a Self-binder.**

No. 99. **Car Ferry, Detroit River.**

No. 83. "A Train Load of Logs."—Frequently logging railways are built for the transportation of logs where the forests are too remote from streams to be hauled profitably on sleds. The scene is a train loaded with logs.

No. 84. "Train Unloading Logs into the river."

No. 85. "A Log Boom."

No. 86. A view showing the entire front of Muir Glacier and a glimpse of Dying Glacier, at the right.

No. 87. "A View of Hermit Glacier, B. C."

No. 88. "A Scene on Great Glacier, B. C.", on the line of the Canadian Pacific Railway.

No. 89. "Ice Cave."—A scene finely adapted to illustrate one of the sources of rivers.

No. 90. "Mt. Sir Donald, B. C."—This is a telescopic view of that celebrated peak in the Canadian Rockies.

No. 91. "Lake Agnes, B. C.," is one of the most ideal of the smaller mountain lakes, surrounded by the castellated crags and peaks which form its almost perpendicular boundaries.

No. 92. "Glacier."—One of the largest of the glaciers in the Canadian Rocky Mountains and may be regarded as typical.

No. 93. "A Watershed and the Source of Rivers."—An ideal view showing how rivers are formed from springs and melting snows on the sides and summits of lofty mountains.

No. 94. "Bridging a Cañon."—The scene is a bridge on the line of the Canadian Pacific Railway built over a cañon, and is over three hundred feet high; it is well suited to illustrate some of the difficulties of building a railway.

No. 95. "Exterior View of Canadian Pacific Railway Snow-sheds."—Asulkan and Great Glacier in the distance.

No. 96. "A View of the Interior of the Snow-sheds on the Canadian Pacific Railway."

No. 97. "Cutting Corn with a Self-binder."—The scene shows two corn binders at work in a field of corn, the growth of which is so high that the ears of corn stand above the backs of the horses.

No. 98. "Combined Harvester and Thresher."—This is a photograph of one of those extremely interesting machines which cuts, threshes and sacks the grain in one operation, much used in the Pacific Coast states.

No. 99. "Car Transfer Boat, Detroit River."—The car ferry

is loaded with an entire passenger train, leaving the docks at Detroit and conveying the same across the river to Windsor.

No. 100. "Threshing Scene, North Dakota."

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(Reprinted from Bulletins 1 and 2).

1. View of Niagara Falls.
2. Minnehaha Falls, Minn.
3. Great Falls of the Missouri River.
4. Black Eagle Falls and Dam.
5. The Falls of the Spokane.
6. Lower Falls of the Spokane.
7. Snoqualmie Falls, Wash.
8. Mineral Hill, Butte, Mont.
9. Harvesting Scene, Blanchard, N. Dak.
10. General View of the Sault Ste. Marie Locks.
11. The Steamship Northwest in St. Mary's River.
12. Fusilade Mountain.
13. Lake McDonald, Mont.
14. Upper End of Lake McDonald.
15. Avalanche Basin.
16. Front of Sperry Glacier.
17. Crevasse in Sperry Glacier.
18. Grinnell Glacier.
19. Chaney Glacier.
20. Emerald Lake, Mont.
21. Summit Lake and Pyramid Valley.
22. Pyramid Peak.
23. General View of Basaltic Formation of the Columbia River.
24 and 25. Detail Structure Palisades of the Columbia.
26. Wenatchee Valley.
27. Approach to the Rocky Mountains.
28. Bad Lands of the Missouri Valley.
29. Docks and City of Seattle.
30. Mt. Rainier from Seattle.
31. A Plowing Scene.
32. One Thousand Acre Wheat Field, Red River Valley.
33. Lake Freight Carriers.
34. Packing Room, Pillsbury A.

35 to 43. Eight scenes from different parts of the world, showing the various methods of harvesting.

43. The Switchback, Great Northern Railway.
44. The Great Northern Railway Switchback on west side of Cascade Range.
45. Extinct Crater near Columbia River, Wash.
46. The Railway Docks, Seattle.
47. Transport Docks.
48. Idzumi Maru.
49. Port Blakely Saw-Mills.
50. The Upper End of Lake Chelan, Wash.

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I.—Four Laboratory Exercises in Geography. II.—A Simple Apparatus to illustrate the Relation between Time and Longitude (illustrated). III.—The Use of the Camera in Geography Teaching. IV.—Illustrated Geographical Compositions. V.—German Maps and Atlasses. VI.—Accuracy in Geography Work. VII.—A Field Lesson: Channel Work as Developed by Pupils of the Fifth Grade. VIII.—The Raison D'Etre in Geography Teaching. IX.—The Significance of the most interesting Names on the Map of the Old World. X.—Magazine Articles in Geography Teaching. XI.—Literature as an Essential Factor in the Teaching of Geography. XII.—The Value of Photomicrography. XIII.—The Concept in Geography. XIV.—The Use of the Lantern in Teaching Geography. XV.—The Old Geography in the Light of the New. XVI.—Typical Stream Study. XVII.—The Child's Mental Processes in getting and using Geographical Notions. XVIII.—Travel as an Aid to the Geography Teacher. XIX.—Aims of Geographic Instruction. XX.—Observations on the Present Status of the Teaching of Geography. XXI.—Type Studies in Geography. XXII.—A Field Lesson on the Mississippi Bluffs. XXIII.—The Value of Field and Laboratory Work in the Teaching of Geography.

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I.—Physical Geography of the Mississippi River (illustrated). II.—The Lower Colorado (illustrated). III.—The Physiography of Washington (illustrated). IV.—The Physiographic Features of California (illustrated). V.—The Nile Country (illustrated). VI.—Some Examples of Folded Strata (illustrated). VII.—Physiographic Features of Oregon (illustrated). VIII.—The Cascade Mountains of Washington (illustrated). IX.—The Sand Reefs of the Carolina Coast (illustrated). X.—Physiographic Features of Minnesota (illustrated). XI.—The Physiography of Georgia (illustrated). XII.—The Topography of Wisconsin (illustrated). XIII.—The Physical Geography of Iowa (illustrated). XIV.—Ascent of Mt. Irazu (illustrated). XV.—Physiographic Features of Indiana (illustrated). XVI.—The Coast of Florida (illustrated). XVII.—Physiographic Features of Ohio (illustrated). XVIII.—Physiographic Features of New Mexico (illustrated). XIX.—Physiographic Features of Wyoming (illustrated). XX.—Physiographic Features of Rhode Island (illustrated). XXI.—Geomorphology of North Carolina (illustrated). XXII.—The Life and Work of a River (illustrated). XXIII.—Mt. Lassen and Cinder Cone Region of Northern California (illustrated).

INDUSTRIAL AND MISCELLANEOUS

I.—The Fishing Industry of New England (illustrated). II.—The Cumberland Iron Ore (with specimens for exchange). III.—The Pecan: Its Culture and Commercial Value (with specimens for exchange). IV.—Cork (illustrated). V.—The Cotton Plant (with specimens for exchange). VI.—The Water Supply of a Great City. VII.—Social Phase of Geography. VIII.—Coral (with specimens from Florida and Hawaiian Islands). IX.—The Story of a Great Industry: The Manufacture of Steel (illustrated and accompanied with specimens for exchange). X.—The Story of a Great Industry: The Manufacture of Paper. XI.—Lead and Zinc Fields of the Ozark Uplift (illustrated). XII.—The Industries of the Pacific Coast (illustrated and accompanied with specimens for exchange). XIII.—The Story of Sand (with specimens of various kinds of Sand). XIV.—The Lake Superior Copper Mining Industry (with specimens for exchange). XV.—Wheat (illustrated). XVI.—Corn (illustrated). XVII.—The Anthracite Coal Mines of Pennsylvania (illustrated and accompanied with specimens for exchange). XVIII.—The Need of Commercial Geography in our Common Schools. XIX.—Geographic Environment. XX.—Applied Geography. XXI.—The Causal Relationship between History and Geography. XXII.—The American Locks at Sault Ste. Marie: Their Development and Importance. XXIII.—Soils of Wisconsin. XXIV.—An Oklahoma Claim. XXV.—Reports of Committees.

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THE AMERICAN BUREAU OF GEOGRAPHY, Winona, Minn.

ANNOUNCEMENTS

One thousand three hundred sets of specimens of zinc and lead ore are being prepared for distribution among the members of the Bureau. This work is under the supervision of Wm. H. Johnson of Forsyth, Mo., promoter of the Frisco mineral displays for the Buffalo Pan-American Exposition of 1901. Each set is expected to consist of four specimens showing four characteristic ores.

It has been arranged to have these specimens sent free of charge to members who have paid their annual dues ($1.00) and are not in arrears.

Among the articles which the March number is expected to contain is "The Lead and Zinc fields of the Ozark Uplift: How lead and zinc is mined and what becomes of it".

This article, together with the specimens expected to accompany it, is one of a series of articles illustrated by both photographs and specimens. Several of these articles are mentioned in our list on the preceding page. Suggestive outlines of these intensely interesting and valuable articles are omitted because of lack of space.

Members should read the report of the Committee on Lantern Slides in this issue, and note that the slides can be secured for twenty-five cents each until March 1, 1901. The negatives for these slides have all been selected with great care and have been secured only after the expenditure of a great deal of time, work, and money. None but the best work is ever sent out, and the committee reports a deficit where a narrow margin had been expected. To enable the committee to continue its work, it has been found necessary to increase the price of our lantern slides. This change, however, does not go into effect until March 1st, and old members are given an opportunity to buy slides at the former price until that date.

Beginning with the March number, the names of only those members will be published who have expressed a desire to exchange geographic material. This change is necessitated by the steadily increasing list of new members and by our desire to hereafter list more fully the materials offered for exchange.

Members should feel free to make suggestions, and should at once send in a list of the materials they can exchange. Remember that what is very commonplace in your vicinity may be of great interest in other parts of our continent.

.....

American Bureau of Geography,
Winona, Minnesota.

_____ *190*....

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BY HARR WAGNER

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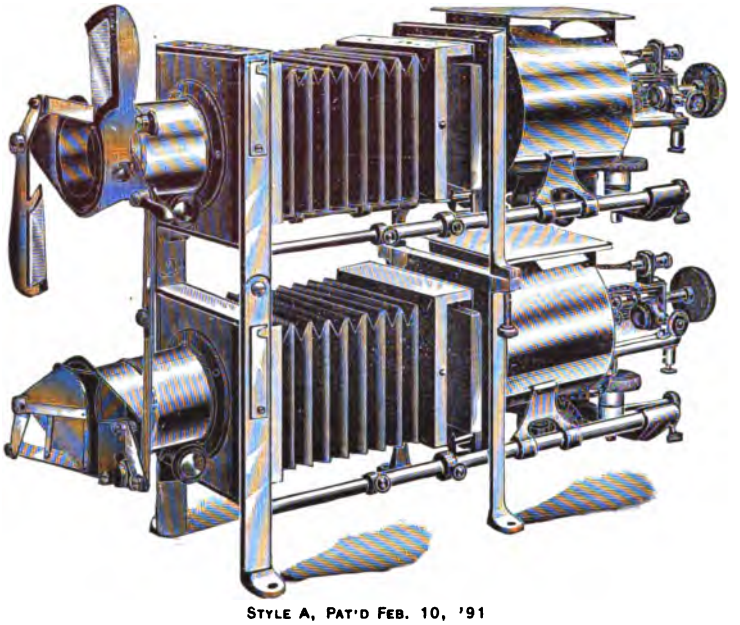

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